1.0 Introduction

Under the U.S. Nuclear Regulatory Commission's (NRC's) environmental protection regulations in Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), which implement the National Environmental Policy Act (NEPA), renewal of a nuclear power plant operating license (OL) requires the preparation of an Environmental Impact Statement (EIS). In preparing the EIS, the NRC staff is required first to issue the statement in draft form for public comment, and then issue a final statement after considering public comments on the draft. To support the preparation of the EIS, the NRC staff has prepared a *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS is intended to (1) provide an understanding of the types and severity of environmental impacts that may occur as a result of license renewal of nuclear power plants under 10 CFR Part 54, (2) identify and assess the impacts that are expected to be generic to license renewal, and (3) support 10 CFR Part 51 to define the number and scope of issues that need to be addressed by the applicants in plant-by-plant renewal proceedings. Use of the GEIS guides the preparation of complete plant-specific information in support of the OL renewal process.

AmerGen Energy Company, LLC (AmerGen), operates the Oyster Creek Nuclear Generating Station (OCNGS) in eastern New Jersey under OL DPR-16, which was issued by the NRC. This OL will expire in April 2009. On July 22, 2005, AmerGen submitted an application to the NRC to renew the OCNGS OL for an additional 20 years under 10 CFR Part 54 (AmerGen 2005a). AmerGen is a *licensee* for the purposes of its current OL and an *applicant* for the renewal of the OL. Pursuant to 10 CFR 54.23 and 51.53(c), AmerGen submitted an Environmental Report (ER) (AmerGen 2005b) in which AmerGen analyzed the environmental impacts associated with the proposed license renewal action, considered alternatives to the proposed action, and evaluated mitigation measures for reducing adverse environmental effects.

This report is the draft plant-specific supplement to the GEIS (the supplemental EIS [SEIS]) for the AmerGen license renewal application. This draft SEIS is a supplement to the GEIS because it relies, in part, on the findings of the GEIS. The NRC staff will also prepare a separate Safety Evaluation Report in accordance with 10 CFR Part 54.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

1.1 Report Contents

The following sections of this introduction (1) describe the background for the preparation of this draft SEIS, including the development of the GEIS and the process the NRC staff used to assess the environmental impacts associated with license renewal, (2) describe the proposed Federal action to renew the OCNGS OL, (3) discuss the purpose and need for the proposed action, and (4) present the status of AmerGen's compliance with environmental quality standards and requirements that have been imposed by Federal, State, regional, and local agencies that are responsible for environmental protection.

The ensuing chapters of this draft SEIS closely parallel the contents and organization of the GEIS. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. Chapters 3 and 4, respectively, discuss the potential environmental impacts of plant refurbishment and plant operation during the renewal term. Chapter 5 contains an evaluation of potential environmental impacts of plant accidents and includes consideration of severe accident mitigation alternatives. Chapter 6 discusses the uranium fuel cycle and solid waste management. Chapter 7 discusses decommissioning, and Chapter 8 discusses alternatives to the station's existing once-through cooling system and alternatives to license renewal. Finally, Chapter 9 summarizes the findings of the preceding chapters and draws conclusions about the adverse impacts that cannot be avoided; the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and the irreversible or irretrievable commitment of resources. Chapter 9 also presents the NRC staff's preliminary recommendation with respect to the proposed license renewal action.

Additional information is included in appendixes. Appendix A contains public comments related to the environmental review for license renewal and NRC staff responses to those comments. Appendixes B through G, respectively, list the following:

- The preparers of the supplement,

- A chronology of the NRC staff's environmental review correspondence related to this draft SEIS,

- The organizations contacted during the development of this draft SEIS,

- AmerGen's compliance status in Table E-1 (this appendix also contains copies of consultation correspondence prepared and sent during the evaluation process),

- GEIS environmental issues that are not applicable to OCNGS, and
- Severe accident mitigation alternatives (SAMAs).

1.2 Background

Use of the GEIS, which examines the possible environmental impacts that could occur as a result of renewing individual nuclear power plant OLs under 10 CFR Part 54, and the established license renewal evaluation process support the thorough evaluation of the impacts of renewal of OLs.

1.2.1 Generic Environmental Impact Statement

The NRC initiated a generic assessment of the environmental impacts associated with the license renewal term to improve the efficiency of the license renewal process by documenting the assessment results and codifying the results in the Commission's regulations. This assessment is provided in the GEIS, which serves as the principal reference for all nuclear power plant license renewal EISs.

The GEIS documents the results of the systematic approach that was taken to evaluate the environmental consequences of renewing the licenses of individual nuclear power plants and operating them for an additional 20 years. For each potential environmental issue, the GEIS (1) describes the activity that affects the environment, (2) identifies the population or resource that is affected, (3) assesses the nature and magnitude of the impact on the affected population or resource, (4) characterizes the significance of the effect for both beneficial and adverse effects, (5) determines whether the results of the analysis apply to all plants, and (6) considers whether additional mitigation measures would be warranted for impacts that would have the same significance level for all plants.

The NRC's standard of significance for impacts was established using the Council on Environmental Quality (CEQ) terminology for "significantly" (40 CFR 1508.27, which requires consideration of both "context" and "intensity"). Using the CEQ terminology, the NRC established three significance levels – SMALL, MODERATE, or LARGE. The definitions of the three significance levels are presented in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, as follows:

> SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The GEIS assigns a significance level to each environmental issue, assuming that ongoing mitigation measures would continue.

The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required in this draft SEIS unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria of Category 1, and, therefore, additional plant-specific review for these issues is required.

In the GEIS, the NRC staff assessed 92 environmental issues and determined that 69 qualified as Category 1 issues, 21 qualified as Category 2 issues, and 2 issues were not categorized. The two uncategorized issues are environmental justice and chronic effects of electromagnetic fields. Environmental justice was not evaluated on a generic basis and must be addressed in a plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared.

Of the 92 issues, 11 are related only to refurbishment, 6 are related only to decommissioning, 67 apply only to operation during the renewal term, and 8 apply to both refurbishment and operation during the renewal term. A summary of the findings for all 92 issues in the GEIS is codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

1.2.2 License Renewal Evaluation Process

An applicant seeking to renew its OL is required to submit an ER as part of its application. The license renewal evaluation process involves careful review of the applicant's ER and assurance that all new and potentially significant information not already addressed in or available during the GEIS evaluation is identified, reviewed, and assessed to verify the environmental impacts of the proposed license renewal.

In accordance with 10 CFR 51.53(c)(2) and (3), the ER submitted by the applicant must

- Provide an analysis of the Category 2 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, in accordance with 10 CFR 51.53(c)(3)(ii), and

- Discuss actions to mitigate any adverse impacts associated with the proposed action and environmental impacts of alternatives to the proposed action.

In accordance with 10 CFR 51.53(c)(2), the ER does not need to

- Consider the economic benefits and costs of the proposed action and alternatives to the proposed action except insofar as such benefits and costs are either (1) essential for making a determination regarding the inclusion of an alternative in the range of alternatives considered, or (2) relevant to mitigation;

- Consider the need for power and other issues not related to the environmental effects of the proposed action and the alternatives;

- Discuss any aspect of the storage of spent fuel within the scope of the generic determination in 10 CFR 51.23(a) in accordance with 10 CFR 51.23(b); and

- Contain an analysis of any Category 1 issue unless there is significant new information on a specific issue – this is pursuant to 10 CFR 51.23(c)(3)(iii) and (iv).

New and significant information is (1) information that identifies a significant environmental issue not covered in the GEIS and codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, or (2) information that was not considered in the analyses summarized in the GEIS and that leads to an impact finding that is different from the finding presented in the GEIS and codified in 10 CFR Part 51.

In preparing to submit its application to renew the OCNGS OL, AmerGen developed a process to ensure that information not addressed in or available during the GEIS evaluation regarding the environmental impacts of license renewal for OCNGS would be properly reviewed before submitting the ER, and to ensure that such new and potentially significant information related to renewal of the OL for OCNGS would be identified, reviewed, and assessed during the period of NRC review. AmerGen reviewed the Category 1 issues that appear in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, to verify that the conclusions of the GEIS remained valid with respect to OCNGS. This review was performed by personnel from AmerGen and its support organization who were familiar with NEPA issues and the scientific disciplines involved in the preparation of a license renewal ER.

The NRC staff also has a process for identifying new and significant information. That process is described in detail in *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*, NUREG-1555, Supplement 1 (NRC 2000). The search for new information includes (1) review of an applicant's ER and the process for discovering and evaluating the significance of new information; (2) review of records of public comments; (3) review of environmental quality standards and regulations; (4) coordination with Federal, State, and local environmental protection and resource agencies; and (5) review of the technical literature. New information discovered by the NRC staff is evaluated for significance using the criteria set forth in the GEIS. For Category 1 issues where new and significant information is identified, reconsideration of the conclusions for those issues is limited in scope to the assessment of the relevant new and significant information; the scope of the assessment does not include other facets of the issue that are not affected by the new information.

Chapters 3 through 7 discuss the environmental issues considered in the GEIS that are applicable to OCNGS. At the beginning of the discussion of each set of issues, there is a table that identifies the issues to be addressed and lists the sections in the GEIS where the issue is discussed. Category 1 and Category 2 issues are listed in separate tables. For Category 1 issues for which there is no new and significant information, the table is followed by a set of short paragraphs that state the GEIS conclusion codified in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, followed by the NRC staff's analysis and conclusion. For Category 2 issues, in addition to the list of GEIS sections where the issue is discussed, the tables list the subparagraph of 10 CFR 51.53(c)(3)(ii) that describes the analysis required and the draft SEIS sections where the analysis is presented. The draft SEIS sections that discuss the Category 2 issues are presented immediately following the table.

The NRC prepares an independent analysis of the environmental impacts of license renewal and compares these impacts with the environmental impacts of alternatives. The evaluation of the AmerGen license renewal application began with publication of a Notice of Acceptance for docketing and opportunity for a hearing in the *Federal Register* (Volume 70, page 54585 [70 FR 54585] [NRC 2005a]) on September 15, 2005. The NRC staff published a Notice of Intent to prepare an EIS and conduct scoping (70 FR 55635 [NRC 2005b]) on September 22, 2005. Two public scoping meetings were held on November 1, 2005, in Toms River, New Jersey. Comments received during the scoping period were summarized in the *Environmental Impact Statement Scoping Process: Summary Report – Oyster Creek Nuclear Generating Station, Ocean County, New Jersey* (NRC 2006) dated February 21, 2006.

Comments that are applicable to this environmental review are presented in Part 1 of Appendix A.

The NRC staff followed the review guidance contained in NUREG-1555, Supplement 1 (NRC 2000). The NRC staff and contractors retained to assist the NRC staff visited the OCNGS site on October 11 through 14, 2005, to gather information and to become familiar with the site and its environs. The NRC staff also reviewed the comments received during scoping and consulted with Federal, State, regional, and local agencies. A list of the organizations consulted is provided in Appendix D. Other documents related to OCNGS were reviewed and are referenced.

This draft SEIS presents the NRC staff's analysis that considers and weighs the environmental effects of the proposed renewal of the OL for OCNGS, the environmental impacts of alternatives to license renewal, the environmental impacts of alternatives to the current once-through cooling system, and mitigation measures available for avoiding adverse environmental effects. Chapter 9, "Summary and Conclusions," provides the NRC staff's preliminary recommendation to the Commission on whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable.

A 75-day comment period will begin on the date of publication of the U.S. Environmental Protection Agency Notice of Filing of the draft SEIS to allow members of the public to comment on the preliminary results of the NRC staff's review. During this comment period, two public meetings will be held in Toms River, New Jersey, in July 2006. During these meetings, the NRC staff will describe the preliminary results of the NRC environmental review and answer questions related to it to provide members of the public with information to assist them in formulating their comments.

1.3 The Proposed Federal Action

The proposed Federal action is renewal of the OL for OCNGS. OCNGS is located in eastern New Jersey adjacent to Barnegat Bay, approximately 60 mi south of Newark, 35 mi north of Atlantic City, and 60 mi east of Philadelphia, Pennsylvania. OCNGS is a single-unit plant with a boiling-water reactor and steam turbine supplied by General Electric. The reactor has a design power level of 1930 megawatts thermal (MW[t]) and a net power output of 640 megawatts electric (MW[e]). Plant cooling is provided by a once-through system that draws water from Barnegat Bay via the South Branch of the Forked River and a man-made intake canal, and that discharges heated water back to Barnegat Bay via a discharge canal and Oyster Creek. OCNGS produces electricity to supply the needs of more than 600,000 customers. The current OL for OCNGS expires on April 9, 2009. By letter dated July 22, 2005, AmerGen submitted an application to the NRC (AmerGen 2005a) to renew this OL for an additional 20 years of operation (i.e., until April 9, 2029).

1.4 The Purpose and Need for the Proposed Action

Although a licensee must have a renewed license to operate a reactor beyond the term of the existing OL, the possession of that license is just one of a number of conditions that must be met for the licensee to continue plant operation during the term of the renewed license. Once an OL is renewed, State regulatory agencies and the owners of the plant will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners.

Thus, for license renewal reviews, the NRC has adopted the following definition of purpose and need (GEIS Section 1.3):

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and where authorized, Federal (other than NRC) decisionmakers.

This definition of purpose and need reflects the Commission's recognition that, unless there are findings in the safety review required by the Atomic Energy Act of 1954 or findings in the NEPA environmental analysis that would lead the NRC to reject a license renewal application, the NRC does not have a role in the energy-planning decisions of State regulators and utility officials as to whether a particular nuclear power plant should continue to operate. From the perspective of the licensee and the State regulatory authority, the purpose of renewing an OL is to maintain the availability of the nuclear plant to meet system energy requirements beyond the current term of the plant's license.

1.5 Compliance and Consultations

AmerGen is required to hold certain Federal, State, and local environmental permits, as well as meet relevant Federal and State statutory requirements. In its ER, AmerGen (2005b) provided a list of the authorizations from Federal, State, and local authorities for current operations as well as environmental approvals and consultations associated with OCNGS license renewal. Authorizations and consultations relevant to the proposed OL renewal action are included in Appendix E.

The NRC staff has reviewed the list and consulted with the appropriate Federal, State, and local agencies to identify any compliance or permit issues or significant environmental issues of concern to the reviewing agencies. These agencies did not identify any new and significant environmental issues. The ER states that AmerGen is in compliance with applicable environmental standards and requirements for OCNGS. The NRC staff has not identified any environmental issues that are both new and significant.

1.6 References

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. *Code of Federal Regulations*, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

40 CFR Part 1508. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 1508, "Terminology and Index."

AmerGen Energy Company, LLC (AmerGen). 2005a. *License Renewal Application, Oyster Creek Nuclear Generating Station, Docket No. 50-219, Facility Operating License No. DPR-16*. Forked River, New Jersey. (July 22, 2005).

AmerGen Energy Company, LLC (AmerGen). 2005b. *Applicant's Environmental Report – Operating License Renewal Stage, Oyster Creek Generating Station*. Docket No. 50-219. Forked River, New Jersey. (July 22, 2005).

Atomic Energy Act of 1954 (AEA). 42 USC 2011, et seq.

National Environmental Policy Act of 1969 (NEPA). 42 USC 4321, et seq.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437, Vols. 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Main Report*, "Section 6.3 – Transportation, Table 9.1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants, Final Report." NUREG-1437, Vol. 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*. NUREG-1555, Supplement 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2005a. "American Energy Company, LLC, Oyster Creek Nuclear Generating Station; Notice of Acceptance for Docketing of the Application and Notice of Opportunity for Hearing Regarding Renewal of Facility Operating License No. DRP-16 for an Additional 20-Year Period." *Federal Register*, Vol. 70, No. 178, pp. 54585–54586. Washington, D.C. (September 15, 2005).

U.S. Nuclear Regulatory Commission (NRC). 2005b. "AmerGen Energy Company, LLC, Oyster Creek Nuclear Generating Station; Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register*, Vol. 70, No. 183, pp. 55635–55637. Washington, D.C. (September 22, 2005).

U.S. Nuclear Regulatory Commission (NRC). 2006. *Environmental Impact Statement Scoping Process: Summary Report – Oyster Creek Nuclear Generating Station, Ocean County, New Jersey*. Washington, D.C. (February 21, 2006).

2.0 Description of Nuclear Power Plant and Site and Plant Interaction with the Environment

The Oyster Creek Nuclear Generating Station (OCNGS) is owned and operated by AmerGen Energy Company, LLC (AmerGen), a wholly owned subsidiary of Exelon Corporation (Exelon). OCNGS is located adjacent to Barnegat Bay in Lacey and Ocean Townships, Ocean County, New Jersey. The plant consists of a single boiling-water reactor that produces steam that turns turbines to generate electricity. The site includes a reactor building, a turbine building, an office building, radioactive waste buildings, a stack, a dry spent fuel storage facility, and several other support buildings. The plant and its environs are described in Section 2.1, and the plant's interaction with the environment is presented in Section 2.2.

2.1 Plant and Site Description and Proposed Plant Operation During the Renewal Term

This section provides a description of the OCNGS plant, the site on which it is located, and the regional setting. In addition, summary descriptions are provided for the reactor system, radioactive waste management and effluent control systems, the cooling- and auxiliary-water systems, the nonradioactive waste management systems, plant operation and maintenance, as well as the power transmission system.

2.1.1 External Appearance and Setting

The OCNGS is located on approximately 800 ac of land. The property is approximately 9 mi south of Toms River, New Jersey, about 50 mi east of Philadelphia, Pennsylvania, 60 mi south of Newark, New Jersey, and 35 mi north of Atlantic City, New Jersey. Barnegat Bay is adjacent to the OCNGS property. Figures 2-1 and 2-2 show the site location and features within 50 mi and 6 mi, respectively (AmerGen 2005a).

The 800-ac OCNGS property boundaries are shown in Figure 2-3. The property lies between two streams, the South Branch of the Forked River (to the north) and Oyster Creek (to the south). During construction, a semicircular canal was dredged between the two streams to create a horseshoe-shaped cooling-water system that consists of the lower reaches of the South Branch of the Forked River, the dredged canal, and the lower reaches of Oyster Creek. Barnegat Bay is adjacent to the property on the east. For condenser cooling, water is withdrawn from Barnegat Bay via the South Branch of the Forked River and man-made intake canal, circulated through the plant's condensers, and returned to the bay via the man-made discharge canal and Oyster Creek (AmerGen 2005a).

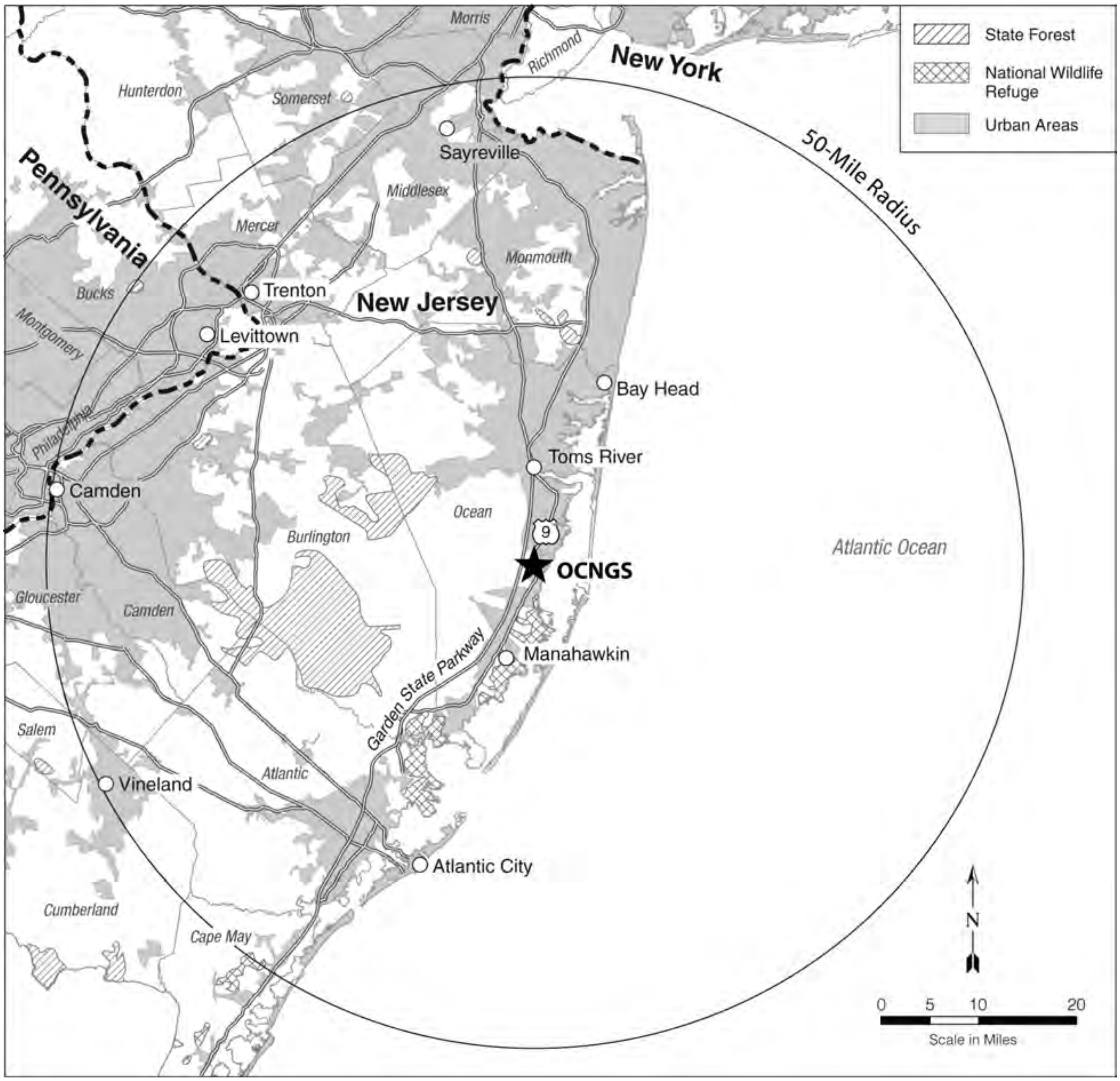

Figure 2-1. Location of Oyster Creek Nuclear Generating Station, 50-mi Region (Source: AmerGen 2005a)

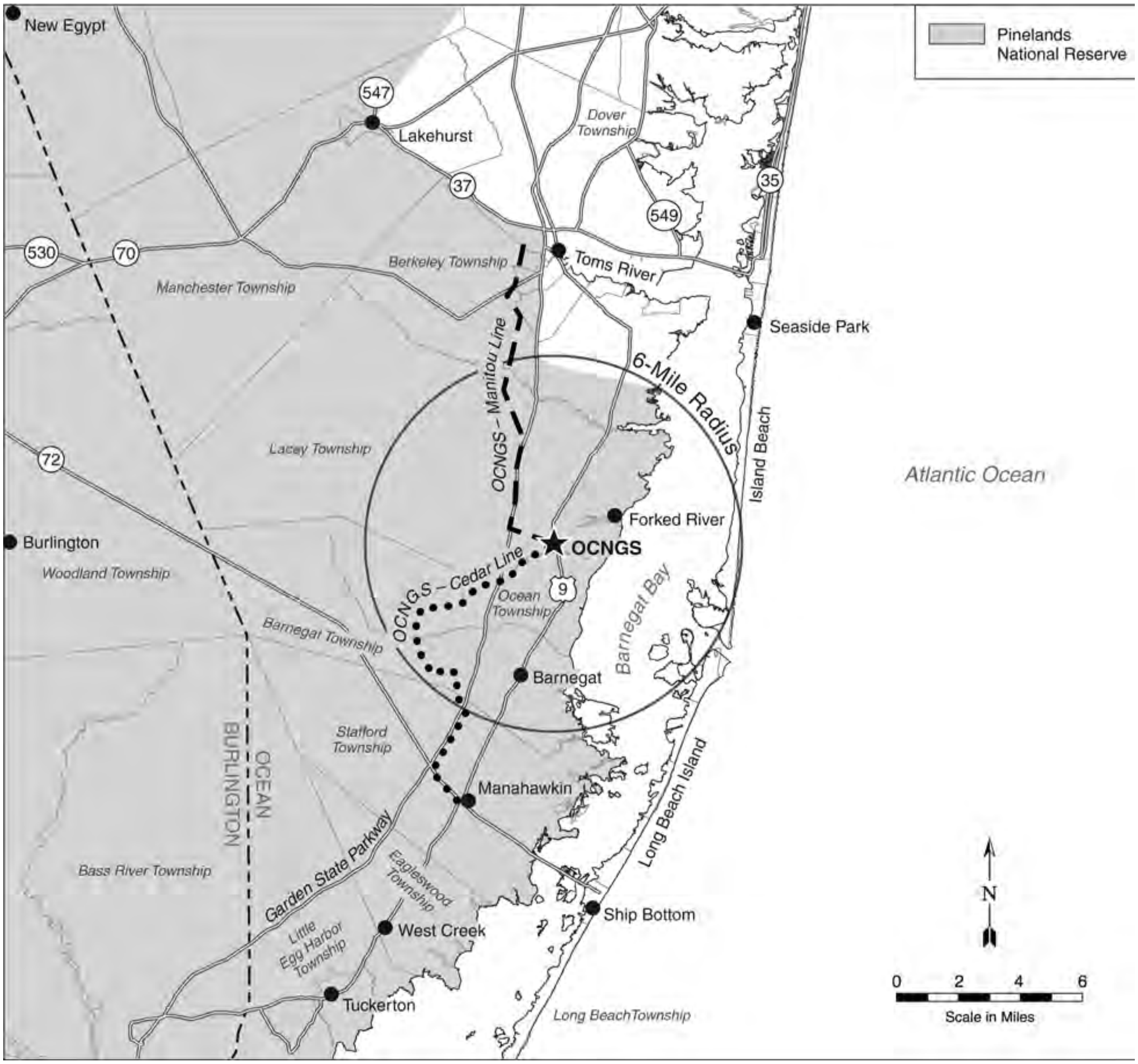

Figure 2-2. Location of Oyster Creek Nuclear Generating Station, 6-mi Region (Source: AmerGen 2005a)

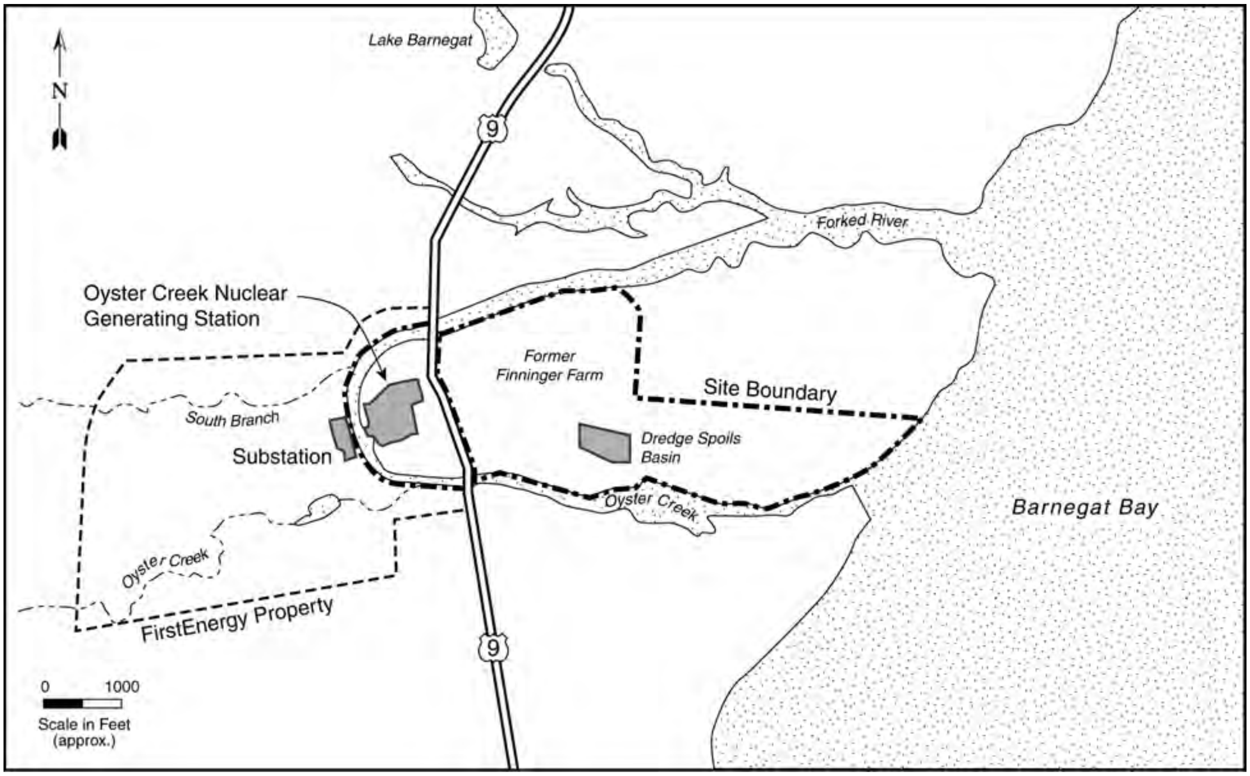

Figure 2-3. Oyster Creek Nuclear Generating Station Site Boundary
(Source: AmerGen 2005a)

As shown in Figure 2-3, the OCNGS property is bisected by U.S. Highway 9. The OCNGS power-generating and supporting facilities are located within an approximately 150-ac area to the west of U.S. Highway 9. The tract of land east of U.S. Highway 9 is approximately 650 ac and is referred to as the former Finninger Farm. The former Finninger Farm is largely undeveloped and contains old fields, abandoned orchards, forests, wetlands, and marshlands. A dredge spoils basin for sediment removed from Oyster Creek and Forked River is also located in this portion of the site (AmerGen 2005a). The property immediately to the west of the OCNGS property is owned by FirstEnergy, an Ohio utility. The FirstEnergy property contains a 66-megawatts-electric (MW[e]) dual-fired combustion turbine power plant that can provide emergency off-site power to OCNGS. In addition, it contains the substation for the OCNGS power transmission system.

The OCNGS property is located in the coastal pine barrens of New Jersey and is within the Pinelands National Reserve (Figure 2-2). The terrain surrounding the site is relatively flat along the shoreline to gently rolling inland. The area immediately surrounding the plant is a mix of vacant lands, agricultural lands, and woodlands. Only about 25 percent of the land in the surrounding area is developed, because development within the Pinelands National Reserve is strictly controlled (AmerGen 2005a).

Based on 2000 U.S. Census Bureau (USCB) data, approximately 4.2 million people live within 50 mi of the site (AmerGen 2005a). The population density of 1132 persons/mi^2 is considered a high population area based on the criteria described in the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a]

Along Barnegat Bay to the east of OCNGS, the land is residentially developed for year-round and seasonal use. Barnegat Bay is bordered by the mainland to the west, Point Pleasant and Bay Head to the north, the barrier islands to the east, and Manahawkin Causeway to the south. Barnegat Bay is a popular summer resort area that experiences large population increases during the summer months. Within a mile of the OCNGS, the summer population is more than double the permanent population (AmerGen 2003a). The bay is enclosed by a barrier beach and is a narrow, shallow tidal basin that is approximately 43 mi long, 3 to 9 mi wide, with an average depth of 5 ft (BBNEP 2002).

The OCNGS lies in an area known geologically as the coastal plain. The coastal plain is underlain by a thick wedge of unconsolidated sediments. The buildings and structures are built generally on Cohansey sand (AmerGen 2003a).

2.1.2 Reactor Systems

OCNGS is a nuclear-powered, steam electric-generating facility that began commercial operation on December 23, 1969. OCNGS is powered by a boiling-water reactor manufactured by General Electric and features a Mark I containment. The unit produces a reactor core power of 1930 megawatts-thermal (MW[t]), with a net electrical capacity of 640 MW(e).

The OCNGS site layout is shown in Figure 2-4. Major buildings and structures include the reactor building, turbine building, administration building, low-level radioactive waste storage building, security building, emergency diesel generator building, intake and discharge structure, ventilation stack, and several storage tanks. The site also includes an independent spent fuel storage facility for dry storage of spent nuclear fuel.

The reactor's primary containment is a pressure suppression system consisting of a dry well, a pressure-absorption chamber, and vent pipes connecting the dry well to the pressure-absorption chamber. The dry well is a steel pressure vessel with a spherical lower portion and

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

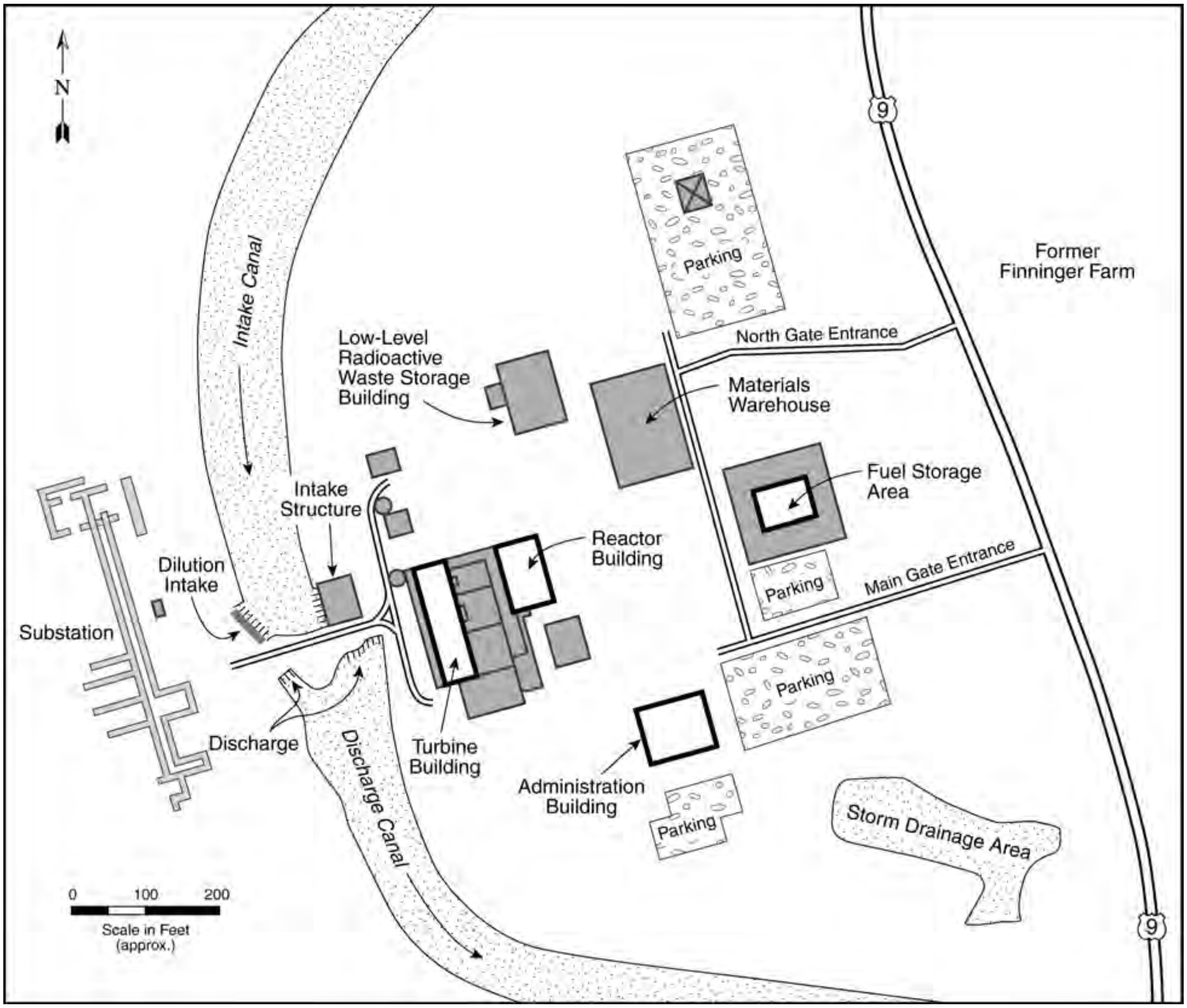

Figure 2-4. Oyster Creek Nuclear Generating Station Site Layout (Source: AmerGen 2005a)

a cylindrical upper portion. The pressure absorption chamber is a steel pressure vessel in the shape of a torus, located below and encircling the dry well, and is approximately half-filled with water. The vent system from the dry well terminates below the water level in the torus, so that in the event of a pipe failure in the dry well, the released steam passes directly to the water where it is condensed (AmerGen 2003a).

Secondary containment is provided by the reactor building, which is constructed of reinforced concrete to the refueling floor. Above the refueling floor, the structure is a steel framework with insulated, corrosion-resistant metal siding. The reactor building also houses all refueling equipment, including the spent fuel storage pool and the new fuel storage vault.

The reactor fuel is uranium dioxide pellets sealed in Zircalloy-2 tubes. The Uranium 235 in the fuel pellets is enriched to no more than 5 percent. The reactor is refueled on a 24-month refueling cycle. Spent fuel is currently stored onsite in the storage pool, as well as in the independent spent fuel storage facility.

2.1.3 Cooling- and Auxiliary-Water Systems

OCNGS has a once-through cooling system that uses water from Barnegat Bay. Cooling water is withdrawn from the bay, first through the lower reaches of the Forked River and then through a 150-ft-wide intake canal. Heated cooling water is discharged to a 150-ft-wide discharge canal that flows into Oyster Creek, which in turn flows into the bay. The intake and discharge canals are divided by a berm (Figure 2-4). Dilution pumps move water from the intake canal directly into the discharge canal to lower the water temperature in the discharge canal. Details on the circulating- and dilution-water systems are presented below. Unless otherwise noted, the discussion of the circulating-water system was taken from the Updated Final Safety Analysis Report (UFSAR) (AmerGen 2003a), the Final Environmental Statement (FES) (AEC 1974), or the Environmental Report (ER) (AmerGen 2005a).

The station intake structure for the circulating-water system has two bays, each equipped with trash bars, a 3/8-in. mesh traveling screen, a screen-wash system, a fish-return system, two service-water pumps, two emergency service-water pumps, and two circulating-water pumps. Each of the circulating-water pumps can provide up to 115,000 gallons per minute (gpm) of cooling water to the condensers. An angled boom in the intake canal immediately in front of the intake prevents large mats of eelgrass and algae from clogging the intake system.

The trash bars consist of almost-vertical steel bars on 3-in. centers with an effective opening of 2.5 in. After passing through the trash bars, water passes through 3/8-in. mesh traveling screens equipped with Ristroph buckets. A low-pressure screen wash washes off aquatic organisms and debris impinged on the traveling screens into the Ristroph buckets. The Ristroph buckets empty into a fish flume that conveys the fish and shellfish to the head of the discharge canal in the area of the dilution pump discharge (NJDEP 2005a). The Ristroph fish-return system improves the survival of the fish impinged on the screens.

Sodium hypochlorite is injected into the circulating-water and plant service-water systems, and chlorine gas is injected into the augmented off-gas/new radioactive waste service-water system to minimize biological fouling in the pipes and condensers. The main condenser's six sections are chlorinated one at a time so that the sections are consecutively chlorinated for 20 minutes each during the daily cycle for a maximum of 2 hours per day of chlorination (NJDEP 2005a).

Each bay of the intake structure has a service-water pump with a pump capacity of 6000 gpm, a second service-water pump with a pump capacity of 2000 gpm, two emergency service-water pumps with a pump capacity of 4150 gpm each, and a screen wash pump with a pump capacity of 900 gpm. These pumps are located immediately downstream of the traveling screens. Service water provides cooling water to the reactor building and turbine building heat exchangers. The service water empties into the discharge canal and mixes with the circulating and dilution water.

The three dilution-water pumps are low-speed, axial flow pumps with 7-ft impellers, and each pump is rated at 260,000 gpm. They are located on the western side of the intake canal and are protected by trash racks. Because the intake to the dilution pumps lacks traveling screens, fish and other aquatic organisms may be drawn through the pumps. There is no fish-return system on the intake to the dilution pumps. The low-flow axial pump design allows for some impingement and entrainment survivability (NJDEP 2005a). The purpose of the dilution pumps is to decrease the temperature of the discharge, which otherwise would encourage migratory fish to stay during the spring and fall, and to reduce thermal stress on organisms in the discharge canal during the summer. The use of the dilution pumps is addressed in the New Jersey Pollutant Discharge Elimination System (NJPDES) permit. Only two of the three pumps operate concurrently during normal operations. During a shutdown, dilution pumping serves to minimize the impact of thermal shock on organisms in Oyster Creek and Barnegat Bay. In the winter, a recirculation tunnel transfers water from the discharge to the intake as needed to prevent icing.

Maximum flow with all circulating pumps and all three dilution pumps working is 1.25 million gpm. At this flow rate, velocities in the intake and discharge canals are typically less than 2.0 ft per second. Typically only two of the three dilution pumps are in operation, so the total flow is typically less than one million gpm.

Intake design and operation are regulated under the Clean Water Act (CWA) through the discharge permitting system. The New Jersey Department of Environmental Protection (NJDEP) has responsibility for issuing the NJPDES permit that addresses the effect of station operation on impingement and entrainment. The July 2005 draft NJPDES permit has not been finalized. The final requirements, limits, and conditions of the renewed permit were not available at the time the U.S. Nuclear Regulatory Commission (NRC) staff performed the assessment presented in this Supplemental Environmental Impact Statement (SEIS). For the purpose of this assessment, the staff has evaluated the impacts of continued operation during the renewal period under the existing expired 1994 permit. However, based on the staff's review of the draft permit and discussions with the NJDEP, the staff has determined that there is a reasonable possibility that OCNGS would be required to install a closed-cycle cooling system. The NRC staff has included a section in Chapter 8 of this SEIS that evaluates the impact of alternatives to the existing once-through cooling system for OCNGS – both a closed-cycle option that uses mechanical-draft cooling towers and a second alternative that includes a combination of design and construction technologies, operational measures, and restoration that would result in compliance with the EPA Phase II intake performance standards (40 CFR Parts 9, 122 et al.).

2.1.4 Radioactive Waste Management Systems and Effluent Control Systems

Radioactive wastes resulting from plant operations are classified as liquid, gaseous, and solid wastes. OCNGS uses liquid, gaseous, and solid radioactive waste management systems to collect and process these wastes before they are released to the environment or shipped to offsite disposal facilities. The waste disposal system meets the release limits as set forth in Title 10, Part 20, of the *Code of Federal Regulations* (10 CFR Part 20) and the dose design objectives of 10 CFR Part 50, Appendix I ("Numerical Guide for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low As is Reasonably Achievable' for Radiological Material in Light-Water-Cooled Nuclear Power Reactor Effluents"), and controls the processing, disposal, and release of radioactive wastes. Unless otherwise noted, the description of the radioactive waste management systems and effluent control systems for liquid, gaseous, and solid wastes presented here (Sections 2.1.4.1, 2.1.4.2, and 2.1.4.3, respectively) is based on information provided in the OCNGS UFSAR (AmerGen 2003a) and was confirmed during the NRC staff's site visit.

The liquid and gaseous radioactive waste systems are designed to reduce the radioactivity in the wastes such that the concentrations in routine discharges are below the applicable regulatory limits. If necessary, liquid waste releases to the discharge canal occur in batches that are monitored during discharge and diluted by the circulating water. However, it is OCNGS operating policy since the late 1980s not to routinely release radioactive liquid effluents to the environment. Gaseous wastes are processed and routed to a common tall stack for release to the atmosphere, or released through rooftop vents on the turbine and off-gas buildings. The liquid and gaseous effluents are continuously monitored, and discharge is stopped if the effluent concentrations exceed predetermined levels.

The Offsite Dose Calculation Manual (ODCM) for OCNGS (AmerGen 2005b) describes the methods used for calculating radioactivity concentrations in the environment and the estimated potential offsite doses associated with liquid and gaseous effluents from OCNGS. The ODCM also specifies controls for release of liquid and gaseous effluents to ensure compliance with NRC regulations.

Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products are contained in the sealed fuel rods; however, as a result of fuel cladding failure and corrosion, small quantities escape from the fuel rods and contaminate the reactor coolant. Neutron activation of the primary coolant system is also responsible for coolant contamination. Nonfuel solid wastes result from treating and separating radionuclides from gases and liquids and from removing contaminated material from various reactor areas. Solid wastes also consist of reactor components, equipment, and tools removed from service as well as contaminated protective clothing, paper, rags, and other trash generated from plant operations, design modification, and routine maintenance activities. The solid waste disposal system is designed to package solid wastes for removal to offsite treatment or disposal facilities. Some solid low-level waste is stored onsite temporarily before offsite shipment.

Fuel assemblies that have exhausted a certain percentage of their fuel and that are removed from the reactor core for disposal are called spent fuel. OCNGS currently operates on a 24-month refueling cycle. Spent fuel is temporarily stored in a spent fuel pool in the reactor building or in an onsite independent spent fuel storage installation.

2.1.4.1 Liquid Waste Processing Systems and Effluent Controls

The liquid radioactive waste system receives and processes all radioactive or potentially radioactive liquid wastes from multiple sources. These wastes are collected in sumps and drain tanks at various locations throughout the plant and then transferred to the appropriate collection tanks in the new radioactive waste building for treatment, storage, and disposal. The liquid wastes received are of different purities and chemical compositions. The liquid radioactive waste system is used to process these wastes to make them suitable for reuse within the plant or, if necessary, for release to the discharge canal where dilution occurs with the circulating water. As noted above, OCNGS has not routinely released liquid wastes since the late 1980s.

The principal sources of liquid wastes are equipment leakage, drainage, and process waste produced by plant operations. Limited segregation is employed to collect wastes with similar levels of chemical contaminants to permit effective treatment. Liquid wastes are broadly categorized into two categories, high-purity waste and chemical/floor drain waste.

The first category, high-purity liquid waste, is liquid effluent with a low conductivity, thus making it generally reclaimable for reuse within the nuclear facility. High-purity liquid waste is processed in two identical process trains, each consisting of a collection tank, feed pump, dewatering filter, demineralizer, resin trap, and sample tank. These wastes are collected in the waste collector tank from a variety of sources, including the equipment drain sumps in the dry well, reactor building, and old radioactive waste building, and from the chemical waste sample tanks.

The high-purity waste is processed through filters and demineralizers. Waste sample tanks are provided to receive filtered demineralized waste from the process trains. Two tanks are provided so that one is available for filling, while the contents of the adjacent tank are being recirculated and sampled prior to discharge. If the water is satisfactory for reuse, it is transferred to the condensate storage tank and used as makeup water. In the event the water is surplus to the plant's makeup requirements, processed wastes can be discharged.

The second category, chemical/floor drain waste, is liquid waste with a relatively high mineral content and/or suspended matter and varying levels of radioactivity. These wastes typically come from floor drain sumps in the dry well, reactor building, old and new radioactive waste buildings, and turbine building, as well as the laboratory drain tank. The chemical/floor drain treatment system consists of either an evaporator-based or a demineralizer-based process train that is fed from three collection tanks. Treated water from this system is normally recycled to the high-purity waste collection tank.

If a release is necessary, processed waste suitable for discharge to the environment is routed to a single monitored release point, which is the termination point of the service-water piping at the discharge canal. Normally, all process wastewater surplus to plant makeup requirements would be discharged to the environment through the high-purity waste system. Wastes being discharged are sampled, analyzed, and released in accordance with the ODCM. This wastewater is diluted by the normal circulating-water system flow.

The NRC staff reviewed the annual liquid effluent releases reported in the OCNGS Annual Radioactive Effluent Release Reports for the years 2000 through 2004 (AmerGen 2001a, 2002a, 2003b, 2004a, 2005b). During this 5-year period, there were no routine liquid effluent releases from the liquid radioactive waste processing system. In 2000, one liquid radioactive discharge consisting of 620 gal containing approximately 0.000014 Ci of tritium was made to the discharge canal. This discharge was the result of flushing the fire service system. AmerGen does not anticipate any significant annual increases in liquid waste effluents during the renewal period. See Section 2.2.7 for a discussion of the theoretical doses to the maximally exposed individual (MEI) as a result of liquid effluent releases.

2.1.4.2 Gaseous Waste Processing Systems and Effluent Controls

At OCNGS, gaseous releases may occur from the 368-ft above-grade plant stack and vents on the turbine and off-gas buildings. Sources of releases from the stack are the main condenser steam-jet air ejectors, building ventilation, and gland seal off-gases. Releases from the turbine building vents result from steam leakage primarily in the heater bay and condenser area. OCNGS ventilation systems are designed to maintain gaseous effluents at levels as low as reasonably achievable. This is done by a combination of holdups for decay of short-lived radioactive material, filtration, and monitoring. Continuous radiation monitoring is provided at various points in the system.

During normal operation, noncondensable gases are produced in the reactor coolant and must be continuously removed to maintain turbine efficiency. These gases include hydrogen and oxygen from radiolysis of water, mixed fission products, activation products, and air from condenser in-leakage. Off-gas is discharged from the condenser via steam-jet air ejectors and passed through holdup piping and high-efficiency particulate air (HEPA) filters before entering the augmented off-gas system. The off-gas is then passed through a flame arrestor and a system where hydrogen and oxygen are catalytically recombined into water. After recombination, the off-gas is routed to a chiller to remove moisture, and then through four charcoal delay beds that provide a long delay period for radioisotope decay as the off-gas passes through. The off-gas is then passed through HEPA filters before it is routed to the 368-ft plant stack for release to the environment.

The NRC staff reviewed the gaseous effluent releases reported in the OCNGS Annual Radioactive Effluent Release Reports for the years 2000 through 2004 (AmerGen 2001a, 2002a, 2003b, 2004a, 2005b). During this 5-year period, the average annual release of radioactive effluents was about 265 Ci/yr, consisting of the following:

- 226 Ci/yr of fission and activation gases,
- 0.21 Ci/yr of iodines,
- 0.024 Ci/yr of beta and gamma emitters as particulates, and
- 38.5 Ci/yr of tritium.

All gaseous effluents were well within the NRC regulatory limits. AmerGen does not anticipate any significant annual increases in gaseous waste effluents during the renewal period. See Section 2.2.7 for a discussion of the theoretical doses to the MEI as a result of gaseous releases.

2.1.4.3 Solid Waste Processing

The solid waste management system at OCNGS is designed to collect, process, store, package, and prepare wet and dry solid radioactive waste materials for offsite shipment. Some solid waste is temporarily stored onsite in shielded structures to permit radioactive decay and/or accumulation prior to shipment from the plant. Solid wastes consist of spent resins, filter sludges, evaporator bottoms, concentrated wastes, dry compressible wastes, air filters from radioactive ventilation systems, irradiated components (control rods, etc.), contaminated clothing and tools, paper and rags from contaminated areas, and used reactor equipment.

The wet solid waste handling system processes concentrated liquid wastes, chemical filter sludges, high-purity filter sludges, reactor water cleanup filter sludges and resins, fuel pool cleanup filter sludges and resins, dewatered sludges, and demineralizer resins from various plant demineralizers. Spent resins are transferred into disposable high-integrity containers fitted with dewatering filters. Concentrated liquid wastes may be solidified or shipped to a licensed processor. A vendor-supplied mobile solidification system can be made available upon demand. Filter sludge may be dewatered similar to spent resin, or solidified similar to concentrated liquid waste.

Dry solid wastes are low-activity-level wastes consisting of contaminated air filters, miscellaneous paper, rags, solid laboratory wastes, clothing, tools, and equipment parts. The dry solid waste is normally stored temporarily in various work areas and then moved to the process area. Most waste of this type has relatively low radioactive content and may be handled manually. This waste is compressed into authorized containers for offsite shipment or interim onsite storage.

Transportation and disposal of solid radioactive wastes are performed in accordance with the applicable requirements of 10 CFR Part 71 and Part 61, respectively. There are no releases to the environment from solid radioactive wastes created at OCNGS. During the period 2000 through 2004, an average of 29 waste shipments per year were made from OCNGS to treatment or disposal facilities. The annual average amount of solid radioactive waste shipped from OCNGS was 1060 m3/yr, containing 4080 Ci/yr of activity (AmerGen 2001a, 2002a, 2003b, 2004a, 2005b). AmerGen does not anticipate any significant annual increase in solid radioactive waste during the renewal period.

2.1.5 Nonradioactive Waste Systems

The principal nonradioactive wastes from OCNGS include various solid waste, chemical waste, and sanitary waste.

Noncontaminated waste is collected inside the restricted area in designated containers located throughout the plant. Once filled, the containers are surveyed for the presence of loose surface contamination and are then transported to the clean material processing facility. Noncontaminated chemicals, paint, oil, fluorescent bulbs, and other items that have either been used or exceeded their useful shelf life are collected in a central collection area. The materials are received in various forms and are processed to meet all regulatory requirements prior to final disposition. Most items are packaged and shipped to vendors for processing offsite.

Sanitary wastewater from all plant locations enters a concrete equalizing tank via a 6-in. sanitary collection main. The equalizing tank discharges via an 8-in. gravity line to the Lacey Municipal Utilities Authority Sewer System and subsequently to the Ocean County Utilities Authority regional collection system. A radiation monitoring system is provided to continuously monitor radiation levels in the effluent.

2.1.6 Plant Operation and Maintenance

Routine maintenance performed on plant systems and components is necessary for the safe and reliable operation of a nuclear power plant. Maintenance activities conducted at OCNGS include inspection, testing, and surveillance to maintain the current licensing basis of the plant and to ensure compliance with environmental and safety requirements. Certain activities can be performed while the reactor is operating. Others require that the plant be shut down. Long-term outages are scheduled for refueling and for certain types of repairs or maintenance, such as the replacement of a major component. The reactor is refueled on a 24-month schedule.

As part of the License Renewal Application (Application), AmerGen conducted an aging management review to manage the impacts of aging on systems, structures, and components in accordance with 10 CFR Part 54. Section 4 of the Application documents the evaluations of time-limited aging analyses (TLAAs) for the license renewal period. Appendix B of the Application provides descriptions of the programs and activities that would manage the impacts of aging for the renewal period. These summary descriptions of aging management program activities and TLAAs would be incorporated into the UFSAR for OCNGS following the issuance of the renewed OL. AmerGen expects to conduct the activities related to the management of aging impacts during plant operation or normal refueling and other outages, but does not plan any outages specifically for the purpose of refurbishment.

2.1.7 Power Transmission System

OCNGS transmits its generated power over the GPU Energy transmission system. The plant depends on the local 34.5-kilovolt (kV) subtransmission and distribution systems to serve as the offsite power source for the OCNGS safety-related loads in the event of a plant trip. A function of the offsite power system is to provide a backup source of alternating current (AC) power to the station when the main generator is incapable of supplying station loads through the auxiliary transformer. Offsite AC power normally supplies the station auxiliary loads through the startup transformers during plant startup. After the station is operating and supplying electric power to the grid, offsite power acts as a standby source of power (AmerGen 2003a).

The connection of the facility with the 34.5-kV GPU Energy system is via the 34.5-kV Oyster Creek substation. The 34.5-kV Oyster Creek substation has two parallel buses with a tie breaker between them. The tie breaker connecting the buses will open automatically if either bus is faulted. Each of the buses can be supplied by a separate line from other GPU Energy substations, following different rights-of-way. Beyond the transformer-side disconnects at the OCNGS substation, the line and corridor easements are owned, operated, and held by FirstEnergy, an Ohio utility (AmerGen 2005a).

The electricity generated by OCNGS is interconnected to the grid through a 230-kV transmission system. The delivery of generated power is via two transmission lines, the OCNGS-to-Manitou and the OCNGS-to-Cedar lines (Figure 2-2). The OCNGS-to-Manitou line is a double-circuit line hung on a single set of steel towers that runs 11.1 mi in a northerly direction from the 230-kV substation at OCNGS to the Manitou substation near Toms River. The OCNGS-to-Cedar connection is through a double-circuit line that is 14 mi long. The transmission line corridor for this line runs in a primarily southerly direction, varies in width from 25 to 100 ft, and portions parallel the Garden State Parkway.

The OCNGS-to-Manitou transmission line corridor is 240 ft wide, approximately parallels the Garden State Parkway, and occupies approximately 320 ac (Figure 2-2). The corridor passes through land that is primarily pine forest and swamp forest; the line is located entirely within the Pinelands National Reserve (Figure 2-2). The areas are mostly remote, with low population densities, but there are some residential subdivisions adjacent to the line. Approximately 1 mi of the line passes through Double Trouble State Park, which is about 12 mi to the north of OCNGS. The line crosses numerous county roads and the Garden State Parkway. FirstEnergy plans to maintain this transmission line, which is integral to the larger transmission system, indefinitely. The transmission line will remain a permanent part of the transmission system even after OCNGS is decommissioned. The OCNGS-to-Manitou line is considered within the scope of the OCNGS license renewal.

The OCNGS-to-Cedar transmission line is owned by Atlantic City Electric (formerly Conectiv), a mid-Atlantic electric distribution company. The line is not considered within the scope of OCNGS license renewal because it was constructed and placed into operation recently. Only transmission lines that originally connected the station to the grid are considered within the scope of license renewal. Although the OCNGS-to-Cedar line is out of scope, it is described here for completeness. An environmental assessment was prepared that evaluated the impacts associated with construction and operation of the OCNGS-to-Cedar line (ENSR International 2004).

Jersey Central Power & Light Company (JCP&L), now a subsidiary of FirstEnergy, designed and constructed the OCNGS-to-Manitou transmission line in accordance with industry guidance that was current when the line was built (AmerGen 2005a). Ongoing surveillance and maintenance of the transmission facilities ensure continued conformance to design standards.

Vegetation management on the OCNGS-to-Manitou transmission line corridor is conducted on a scheduled 4-year rotation. For the OCNGS-to-Manitou line, the maintained portion of the corridor extends 30 ft to either side of the line. Within this clear zone all trees with diameters greater than 6 in. at 4.5 ft from the ground are pruned such that the pruning will result in 4 years of adequate clearance. If a tree must be removed at the stump (at ground level), the stump is treated with herbicide by licensed applicators to prevent resprouting. However, a majority of the transmission line is located on land administered by the New Jersey Pinelands Commission, and herbicide use is not allowed on these locations. Vegetation management on these portions of the corridor consists of cutting only.

The transmission line corridor is examined twice yearly for vegetation-management issues; one of the examinations is conducted entirely from low-flying aircraft. The 4-year vegetation treatment cycle includes a combination of hand cutting, mowing, and low-spray herbicide application. As stated, no herbicides are used on lands under the administration of the New Jersey Pinelands Commission. The Pinelands Commission will be issuing comprehensive vegetation-management guidelines for rights-of-way on its lands during 2007, and these new guidelines will be incorporated by FirstEnergy.

Vegetation management on the OCNGS-to-Manitou transmission line corridor follows NJDEP guidelines for Integrated Pest Management and the Edison Electric Institute Environmental Stewardship Strategy for Electric Utility Rights-of-Way. The guidelines stress the importance of developing a low-growing, sustainable vegetation community that will not pose a hazard to the transmission facilities. The primary means of accomplishing this goal is a combination of mechanical removal of large trees and application of herbicides to a selected group of plant species, primarily trees, to prevent regrowth. Manual and mechanical cutting (usually with a bush hog or similar powered cutting device) results in woody debris that can be used as windrows, or chipped and left onsite to enrich the soil. Mechanical methods allow very specific control of key danger trees and are employed exclusively near and around wetland locations to avoid the use of herbicides.

Chemical herbicides are only used on a small portion of the southern and northern ends of the line to treat incompatible tall-growing trees and vines. All chemicals that are used for vegetation management are approved for that use by the U.S. Environmental Protection Agency (EPA). In addition, the State of New Jersey requires that all individuals employed by FirstEnergy who apply herbicide:

- View the Edison Electric Institute Environmental Stewardship Strategy for Electric Utility Rights-of-Way videotape and supporting documents,

- Possess a valid Commercial Pesticide Applicator license issued by the NJDEP, and

- Are certified in Category 6B (Right-of-Way Pest Control).

The application of herbicides follows general best management practices and includes:

- Spot treatments, if and where available, that target specific species;

- Application under appropriate environmental conditions (i.e., no spraying on windy days or immediately prior to forecast of heavy rain); and

- Application through the use of appropriate drift reduction techniques, such as the use of low-pressure sprayers when possible.

2.2 Plant Interaction with the Environment

Sections 2.2.1 through 2.2.8 provide general descriptions of the environment near OCNGS as background information. They also provide detailed descriptions where needed to support the analysis of potential environmental impacts of refurbishment and operation during the renewal term, as discussed in Chapters 3 and 4. Section 2.2.9 describes the historic and archaeological resources in the area, and Section 2.2.10 describes possible impacts associated with other Federal project activities.

2.2.1 Land Use

The OCNGS site is located in Lacey and Ocean Townships, Ocean County, on the southeastern coast of New Jersey, and about 9 mi south of Toms River, New Jersey. OCNGS plant facilities are located approximately 2 mi inland from Barnegat Bay on 152 ac of land located between Oyster Creek to the south, the South Branch of the Forked River to the north, and U.S. Highway 9 to the east (Figure 2-2). The land to the east of U.S. Highway 9 (about 650 ac) was formerly farmland (the Finninger Farm; Figure 2-3) that is undergoing succession; vegetation currently consists of grasses, native pines, and small oaks (AmerGen 2005a). Material dredged from Oyster Creek and the South Branch of the Forked River has been placed in a dredge spoils basin on the former Finninger Farm (Figure 2-3).

The nearest population center is the Forked River Beach housing development, located on the shoreline at the mouth of the Forked River, approximately 1 mi east of the OCNGS site. The OCNGS site is located in the Pinelands National Reserve and is adjacent to Barnegat Bay, which draws large numbers of summer visitors (AmerGen 2003a). A State game farm located approximately 2 mi north of the site is used for raising quail and pheasant (AmerGen 2005a).

The OCNGS site lies on the New Jersey Coastal Plain. The area in which the site is located varies from relatively flat along the shoreline to rolling inland. The majority of the area in the immediate vicinity of the OCNGS site consists of abandoned farmland (65 percent), forested land (25 percent), and surface water (10 percent) (AmerGen 2005a).

A number of buildings and other permanent structures occupy approximately 80 ac of the OCNGS site. These include an intake structure, a turbine building, a reactor containment building, an administration building, and a waste storage building (AmerGen 2005a; Figure 2-4).

The plant area is fenced off from the remainder of the owner-controlled area, and is under the control of plant security personnel. The site boundary of the owner-controlled area is posted (AmerGen 2005a).

Section 307(c)(3)(A) of the Coastal Zone Management Act (United States Code, Title 16, Section 1456(c)(3)(A) [16 USC 1456(c)(3)(A)]) requires that applicants for Federal licenses certify that any proposed activity in a coastal zone is consistent with the enforceable policies of the State's coastal zone program (NRC 2004). A copy of the certification is also to be provided to the State. The State is to notify the Federal agency whether the State concurs with or objects to the applicant's certification. This notification is to occur within 6 months of the State's receipt of the certification. OCNGS is within New Jersey's coastal zone for purposes of the Act (NJDEP 2005b).

On January 21, 2005, AmerGen submitted an application (in AmerGen 2005a) for a Federal Consistency Determination Request for license renewal for OCNGS by the NRC. On August 19, 2005, the NJDEP determined that AmerGen’s request for a Federal consistency determination to be inconsistent with New Jersey’s Coastal Zone Management Plan primarily because there was insufficient information in the January 21, 2005 application (NJDEP 2005i). Under the provisions of an September 19, 2005, Memorandum of Understanding, negotiated by the U.S. Department of Commerce, National Marine Fisheries Service (NMFS), between the NJDEP and AmerGen (provided in Appendix E), AmerGen withdrew its consistency certification, and the NJDEP withdrew its consistency objection. AmerGen will resubmit its consistency certification at an appropriate time during the NRC review. Once NJDEP receives AmerGen’s consistency certification and necessary data and information, NJDEP’s six-month review period shall begin. As of the date of this draft SEIS, AmerGen has not resubmitted its certification of consistency to the NJDEP.

2.2.2 Water Use

Construction of OCNGS in the 1960s resulted in the dredging and widening of portions of the South Branch of Forked River and Oyster Creek. Dredged material from construction was placed on the OCNGS site. Oyster Creek was again dredged in 1978, and the South Branch of the Forked River was dredged in 1984 and 1997 (URSGWC 2000). Depth monitoring takes place every two years. Materials dredged in 1978, 1984, and 1987 were placed in a 17.5-ac bermed area on the former Finninger Farm (Figure 2-3). Characteristics of dredged sediments are presented in Section 2.2.3.

As described in Section 2.1.3, the facility uses water in the circulating-water system, the service-water system, and the dilution-water system. Other plant uses are detailed below.

The fire pond is a source of water for fire fighting at OCNGS. It was created by damming Oyster Creek in approximately 1963. Water naturally exits the pond by flowing over the dam. The pond is owned by JCP&L and leased by AmerGen. Freshwater from the fire pond also is used for dilution pump lube oil cooling and pump seal water (NJDEP 2005a).

A pipe runs over the top of the water surface of the intake canal along the east side of the U.S. Highway 9 bridge over the river. The original purpose of this pipe was to supply water to basins on the OCNGS property as a means of addressing possible saltwater intrusion into aquifers. However, this potential problem was determined to be of no concern, and the pipe is inactive.

OCNGS lies in the Atlantic Coastal Plain physiographic province. The site's near-surface geology consists of the Pleistocene Cape May Formation over the Miocene Kirkwood-Cohansey Formation. URSGWC (2000) summarized the local geology and hydrogeology. The Cape May Formation is predominantly a medium to fine sand. The Cohansey Formation is a medium to fine sand with clay lenses, while the Kirkwood Formation is a very fine to fine sand with some coarse to fine gravel. The Cape May and Cohansey Formations generally function as a single, unconfined hydrologic unit, while the Kirkwood Formation exhibits confined conditions. At the site, the Cape May Formation is a sandy unit typically 20 ft thick and underlain by clay that is typically 15 to 18 ft thick, if not breached by an excavation. The Cohansey Formation is about 60 to 75 ft thick and is underlain by 10 to 20 ft of thick clay. The Kirkwood Formation is below this clay. In combination, the Kirkwood-Cohansey Formation may range in thickness up to 350 ft, and well yields are typically 500 to 1000 gpm (USGS 2001). A thick sequence of additional coastal plain sediments underlies the Kirkwood-Cohansey Formations (USGS 2001).

Two onsite groundwater wells provide water for reactor makeup, potable and nonpotable domestic uses, and the sanitation system. Information on the two production wells at OCNGS is available in a water use registration (NJDEP 2001a), which is required for users of less than 100,000 gallons per day (gpd). The South Well was drilled in 1964 to a depth of 300 ft and is finished in the Kirkwood-Cohansey Formation aquifer. Its yield is 600 gpm and its pumping capacity is 200 gpm. It is located south of the turbine building, between the diesel generator building and the machine shop, and is used for makeup and potable domestic water. It is flush-mounted, with aboveground controls. The North Well was drilled in 1987 to a depth of 162 ft and is also finished in the Kirkwood-Cohansey Formation aquifer. Its yield is 300 gpm and its pumping capacity is 225 gpm. The North Well is used for potable domestic water for the administration and cafeteria buildings, and it may be used for makeup water if needed. It is located at the northwestern corner of the north parking lot.

The wells' water usages are metered, with meter calibration every five years (NJDEP 2001a). The total combined pumping capacity for the North and South Wells is 425 gpm. The actual total production of these wells during 2001 was 7,379,654 gal or an average of 14 gpm over the year. In 2001, the South Well produced 5,205,454 gal (9.9 gpm) and the North Well produced

2,174,200 gal (4.1 gpm) (AmerGen 2005a). Extraction wells for groundwater remediation are discussed in Section 2.2.3.

The NJDEP maintains a website of permits, inspections, and violations pertaining to water supply systems (NJDEP 2005d). The system shows two inspections of the North and South Wells since the startup of the online information system in July 2000. Both June 2003 and June 2005 inspections resulted in no violations related to the groundwater production wells.

2.2.3 Water Quality

The water quality of OCNGS effluents is regulated through the NJPDES program. The NJPDES permit specifies the discharge standards and monitoring requirements for each discharge. Compliance with the NJPDES process, other provisions of the CWA (e.g., Sections 316(a), 316(b), 401, and 404), and other regulatory requirements are expected to provide adequate control of potential effluent effects. Under these regulatory programs, AmerGen treats wastewater effluents, collects and properly disposes of potential contaminants, and undertakes pollution prevention activities that comply with regulatory requirements and minimize the risk of adverse environmental impacts.

The NJPDES permit was issued in 1994 (NJDEP 1994) and expired in 1999. A provision of the CWA allows facilities to continue to operate under an expired permit provided that the permittee makes a timely renewal application, which is the case with OCNGS. A draft permit was issued by the NJDEP in July 2005 (NJDEP 2005a), that emphasized the goal of reducing impingement and entrainment losses at the facility. In July 2004, the EPA issued Phase II regulations for existing electric-generating plants. These regulations established performance standards with respect to Section 316(b) of the CWA. These regulations call for reducing the number of organisms impinged by the intake system by 80 to 95 percent of baseline, and reducing organisms entrained into the cooling system by 60 to 90 percent of baseline (EPA 2004). The draft permit provides the licensee two alternatives. The first is to reduce intake flow to the level commensurate of that of closed-cycle cooling. The second alternative, should a closed-cycle cooling system not be a feasible alternative for OCNGS then AmerGen is to install and operate a combination of design and construction technologies, operational measures, and restoration measures with the goal of meeting the impingement and entrainment performance criteria. The second alternative would also require the licensee to begin a wetlands restoration and enhancement program in the Barnegat Bay watershed. Preliminary State calculations suggest that the licensee could require a significant amount of wetland restoration to equalize the losses from entrainment and impingement. As of the date of publication of the draft SEIS, NJDEP has not issued a final NJPDES permit.

OCNGS has seven NJPDES discharge locations. These are described in detail in an NJDEP fact sheet (NJDEP 2005a). The discharges are summarized in Table 2-1.

Table 2-1. OCNGS NJPDES Discharge Locations

Discharge Name	Flow Rate (gpd)	Description
DSN001A	592,000,000	Chlorinated, once-through, noncontact cooling water from the circulating-water and service-water systems. Discharged to the discharge canal.
DSN002A	3,500,000	Chlorinated, noncontact cooling water from the radioactive waste treatment system's heat exchanger and augmented off-gas heat exchanger. Discharged to the intake canal.
DSN004A	60,000	Stormwater, noncontact cooling water from the reactor building and emergency service-water heat exchangers, laboratory and sampling streams, and floor drains by sumps. Discharged to the discharge canal.
DSN005A	732,000,000	Dilution water pumped directly from the intake canal to the discharge canal.
DSN007A	30	Dilution pump seal wastewater treated by an oil/water separator. Discharged to the intake canal.
DSN008A	2,400,000	Intake screen washwater. Originally into hot discharge, but now in an underwater discharge in the seawall between DSN001A and DSN005A.
DSN009A	Used only as needed	Fish sampling pool, discharged to the intake canal.

Source: NJDEP 2005a

Water-related information since July 2000 is available on the NJDEP website (NJDEP 2005d). On September 23, 2002, the dilution pumps were turned off during maintenance, resulting in a water temperature increase and a fish kill (NJDEP 2005d). The event was prosecuted by the State of New Jersey, and a fine was levied against the applicant. Other NJPDES sampling events and standard compliance inspections during the period covered by the online system showed no violations. The system also includes Discharge Monitoring Report data since July 2000. Monitoring data include chlorine-produced oxidants (total residual chlorine), flow, toxicity testing, net rate of addition of heat, pH, water temperature, temperature difference between intake and discharge, velocity at intake, total suspended solids (TSS), petroleum hydrocarbons, and total organic carbon. Downstream water temperature is also monitored at the U.S. Highway 9 bridge over Oyster Creek.

Other NJPDES violations that occurred prior to the initiation of the online tracking system were identified during interviews with OCNGS staff. The described violations include failure to collect samples, oil/water separator malfunction and minor discharges at DSN007A, total residual chlorine exceedence due to malfunction, and violations of the TSS limit at a wastewater treatment plant discharge at DSN004A in the 1980s.

Originally, OCNGS had its own wastewater treatment plant, with discharge to DSN004A. In 1982, the plant connected to the municipal sewage system of the Lacey Township Municipal Utilities Authority (URSGWC 2000; NJDEP 2005a). Continuous radiological monitoring of wastewater is performed before it leaves the site. Sampling is performed periodically and reported to the municipality.

Dredging of Oyster Creek and the Forked River is administered by the U.S. Army Corps of Engineers (USACE) and a Coastal Area Facility Review under the New Jersey Coastal Zone Management Act. Suction dredging has been performed to minimize the impact of the dredging, and dredged materials have been conveyed to the dredge spoils basin (Figure 2-3) using hard piping. During the license renewal period, periodic dredging may take place in the intake and discharge canals, the Forked River, or Oyster Creek. The dredging would be consistent with past techniques and requirements.

The sale of OCNGS from JCP&L to AmerGen in 2000 triggered an Industrial Site Recovery Act (ISRA) investigation under New Jersey State law. Under the ISRA, a Preliminary Assessment (PA) was conducted in 1998 to 1999, followed by a Site Investigation/Remedial Investigation (SI/RI) performed in 1999 to 2000 (URSGWC 2000). These investigations focused on nonradiological issues. Potential radiological environmental problems were addressed during the ISRA assessment in a companion document, a combined PA/SI (McLaren/Hart, Inc. 2000). These documents provided information on numerous areas of concern (AOCs) at the site and described releases to groundwater, soil, surface water, and sediment, all of which may have potential impacts on water quality.

The nonradiological SI/RI assessment (URSGWC 2000) detailed the history, usage, and potential problems at more than 100 AOCs, including hydrocarbon fuel storage areas, transformers, waste storage areas, and others. For the bulk of the AOCs, the report recommended no further action on the basis of sampling results. For seven AOCs, however, there were exceedences of State soil or groundwater cleanup criteria for volatile organic compounds (VOCs) (chlorobenzene, methyl tertiary-butyl ether [MTBE], tetrachloroethene, and trichloroethene), total polychlorinated biphenyls (PCBs), and metals (antimony, thallium, and zinc). These issues, which are described below, were recommended for future remedial action.

The chlorobenzene exceedence was a sample taken at the site's former wastewater treatment facility. The soil sample had a concentration of 1.6 mg/kg; the State limit is 1 mg/kg (URSGWC 2000). Use of this facility ended with connection to the municipal sewer system in 1982.

Thallium was detected in a soil sample at a seepage pit associated with maintenance of water treatment equipment used in facility processes. The maximum concentration was 8.3 mg/kg; the State limit is 2 mg/kg (URSGWC 2000).

Metals were found in soil samples at a former sand blasting site at OCNGS. Concentrations were up to 22.9 mg/kg of antimony and 1790 mg/kg of zinc; the State limits are 14 and 1500 mg/kg, respectively (URSGWC 2000).

In October 1986, a diesel fuel line leak was discovered near the diesel generator building. Approximately 15,000 gal of fuel leaked into the soil and groundwater (JCP&L 2003). Petroleum compounds appear to be within the upper Cape May Formation, which is generally separated from the lower Cohansey Formation by a clay layer throughout most of the site. Although this clay is 15 ft thick, it was breached during foundation construction around the turbine and reactor buildings. Recovery wells on the eastern side of the diesel generator building extract both groundwater and hydrocarbons, and a monitoring well network is used to assess hydraulic gradients and contaminant concentrations. The water table is approximately 13 ft below ground surface (URSGWC 1999). February 1999 measurements showed up to 0.4 ft of fuel oil on the water table (URSGWC 1999). April 2002 data were similar (JCP&L 2003). A group of injection wells located between the contaminant source area and the turbine building is used to force potable water between the contaminated groundwater and the breach in the clay unit, thereby protecting the Cohansey Formation from shallower groundwater contamination. The injection water is obtained from the South Well. The fuel remains generally contained between the machine shop and the diesel generator building, with hydraulic gradients toward the recovery wells (JCP&L 2003). The South Well was monitored as a precaution for one year following the diesel leakage.

Subsurface diesel movement was influenced by nearby infrastructure. A 30-in. pipe that conveys water to DSN004A is located near the leak. Diesel fuel followed the backfill material around the pipe. An excavation was conducted to remove the contaminated backfill and replace it with a bentonite-based backfill. A well point was installed in this location to collect diesel fuel.

Water and product extracted by the set of recovery wells undergo treatment at an onsite facility that was installed in 1994 (JCP&L 2003). Discharge of the water from the operation of the groundwater treatment system to the sanitary sewer system is permitted by the county (Appendix E). The permit allows for self-monitoring, with limits on flow, pH, TSS, chemical oxygen demand, petroleum hydrocarbons, benzene, toluene, ethylbenzene, and total xylenes.

Tetrachloroethene was discovered during the diesel leak investigation. This contaminant was attributed to spills and spraying of the solvent, which was kept in drum racks formerly along the eastern side of the storage building. The concentration in groundwater ranges up to 400 µg/L; the State limit is 1 µg/L. May 2002 measurements showed values up to 26 µg/L (JCP&L 2003).

The May sampling also showed a detection of trichloroethene in one well at 4.4 µg/L; the State limit is 1 µg/L (JCP&L 2003). In the 1970s, a warehouse was constructed for housing these drums, and outdoor storage ceased.

Ongoing oversight of the remediation and monitoring systems for both diesel fuel and VOCs is being conducted by the New Jersey Bureau of Environmental Evaluation, Cleanup, and Responsibility Assessment (JCP&L 2003).

The ISRA process discovered MTBE in groundwater at the northern end of the north parking lot (URSGWC 2000). This compound is associated with gasoline, and its presence is attributed to a filling station or to occasional spills from aboveground tanks. A concentration of 1000 g/L was measured, which exceeds the State limit of 70 g/L. JCP&L has assessed the plume with a monitoring well network. Sampling in 2004 showed decreasing trends and all concentrations below the regulatory limit. The NJDEP has called for no further action (NJDEP 2006a). A 1991 closure of another aboveground tank facility because of soil and groundwater contamination was reviewed by the NJDEP (URSGWC 1999).

At the M1B Main Transformer, 300 gal of dielectric fluid (without PCBs) leaked in July 1989 (URS 2005). Several hundred cubic yards of soil were excavated due to the discovery of PCBs in the soil. These PCBs were attributed to leaks from prior use of PCB-containing dielectric fluids. Some soils that exceeded a total petroleum hydrocarbon limit were left in place because excavation of them would have jeopardized the integrity of nearby structures (URS 2005). As a result of the incident, yearly pressure testing of pipelines began in an effort to avoid another failed line (URSGWC 2000). Ongoing groundwater monitoring has been taking place under a Memorandum of Agreement with the NJDEP (URSGWC 2000). PCBs were discovered in subsurface soil samples at several of the site's other transformers. The PCB concentration was up to 2.1 parts per million (ppm); the State limit is 0.49 ppm (URSGWC 2000). Groundwater sampling at one transformer location indicated tetrachloroethene levels as high as 6.7 g/L.

Supplemental remedial activities were conducted in 2002 (URS 2005). The tasks under these assessments included additional soil sampling, monitoring well installation, and groundwater sampling. Despite the sale of OCNGS, JCP&L retained responsibility for nonradiological environmental liabilities associated with its past operations at the site.

The radiological preliminary site assessment (McLaren/Hart, Inc. 2000) addressed many potential radiological AOCs. Soil sampling conducted within site drainages showed radiological contamination indicators cobalt-60 and cesium-137 at or below background levels. Sediment sampling in the discharge canal in 1994 through 1998 indicated decreasing cesium-137 in sediment samples attributed to decreased liquid discharges since 1989 (McLaren/Hart, Inc. 2000). Four groundwater monitoring wells downgradient of the reactor building showed no radionuclides above background levels.

The radiological preliminary site assessment (McLaren/Hart, Inc. 2000) documents a number of historical onsite releases of potentially contaminated water to site soils. Onsite soil sampling has indicated cobalt-60 and cesium-137 contamination above background levels in several locations, some of which have been excavated, removed, and disposed of in accordance with NRC regulations. Numerous other portions of the site were considered in the radiological assessment; radionuclides in soil, sediment, surface water, or groundwater (if detectable) were generally at background levels.

Prior to the 1997 dredging, 86 soil samples were collected at the dredge spoils basin located on the Finninger Farm portion of the OCNGS site (Figure 2-3). These samples represent dredged sediments from dredging actions conducted after OCNGS became operational. Samples were analyzed for cobalt-60 and cesium-137. One sample had detectable cobalt-60 at 0.075 pCi/g. Forty samples had detectable cesium-137, with a maximum activity concentration of 0.42 pCi/g. A total of nine Forked River sediment cores were collected prior to the 1997 dredging project. Eight of the samples had detectable cobalt-60 and cesium-137, with maximum activity concentrations of 0.088 pCi/g and 0.27 pCi/g, respectively.

Annual environmental monitoring of the site and its surroundings is conducted under the Radiological Environmental Monitoring Program (REMP). REMP reports include surface water, groundwater, and sediment sampling results. Monitoring results for the 5-year period of 2000 through 2004 indicate that the radiation and radioactivity in the environmental media monitored around the plant are well within applicable regulatory limits. The only radionuclide consistently detected is cesium-137 in sediment, a result of historical plant releases and fallout from nuclear weapons testing (AmerGen 2001b, 2002b, 2003c, 2004b, 2005c).

2.2.4 Air Quality

Although New Jersey is one of the smallest states in the United States, it has five distinct climatic regions. The geology, distance from the Atlantic Ocean, and prevailing atmospheric flow patterns produce distinct variations in the daily weather in each of the climatic regions (Northern, Central, Pine Barrens, Southwestern, and Coastal). With its coastal location, OCNGS experiences both continental and oceanic influences that compete for dominance. In autumn and early winter when the ocean is warmer than the land surface, the Coastal region experiences warmer temperatures than interior regions of the State. In the spring months, ocean breezes keep temperatures along the coast cooler. Being adjacent to the Atlantic Ocean, with its high heat capacity (compared with land), seasonal temperature fluctuations tend to be more gradual and less prone to extremes (Ludlum 1983).

Sea breezes play a major role in the coastal climate. When the land is warmed by the sun, heated air rises, allowing cooler air at the ocean surface to spread inland. Sea breezes often penetrate 5 to 10 mi inland, but under more favorable conditions can affect locations 25 to 40 mi inland. Sea breezes are most common in spring and summer.

Coastal storms, often characterized as Nor'easters, are most frequent between October and April. These storms track over the coastal plain or up to several hundred miles offshore, bringing strong winds and heavy rains. Rarely does a winter go by without at least 1 significant coastal storm; sometimes there are 5 to 10 in a year. Tropical storms and hurricanes are also a special concern along the coast. In some years, they contribute a significant amount to the precipitation totals of the region. Coastal damage during times of high tide can be severe when tropical storms or Nor'easters affect the region (Ludlum 1983).

Meteorological records from the National Weather Service Toms River cooperative weather station (Coop ID 288816) are generally representative of the OCNGS site. Mean or normal daily minimum and maximum temperatures measured at Toms River from 1971 through 2000 range from 21.8 °F in January to 63.8 °F in July, and from 40.6 °F in January to 86.1 °F in August, respectively (ONJSC 2005). Day-night temperatures typically vary by 20 to 25 °F throughout the year. Mean or normal monthly temperatures for the same period range from 31.2 °F in January to 75.0 °F in July (ONJSC 2005). Local precipitation occurs throughout the year, with only slight increases in rainfall over the annual average during the summer months. Measurable precipitation falls on approximately 120 days each year. Fall months are usually the driest with an average of eight days of measurable precipitation. Other seasons average between 9 and 12 days of precipitation per month. The highest and lowest monthly precipitation typically occur in August (5 in.) and October (3.6 in.), respectively. The mean annual precipitation for the region is 48.8 in. (ONJSC 2005).

Most areas of New Jersey receive 25 to 30 thunderstorms per year, with fewer storms near the coast than farther inland. Statewide, approximately five tornadoes occur each year, and in general, they tend to be weak. Over the past 55 years, severe thunderstorms with winds exceeding 58 mph and/or with property damage or injury occurred on average about once every other year (NOAA 2005). During the period from the middle of March to the middle of November, the daily occurrence of thunderstorms with high winds was rare, with a total of only 20 severe thunderstorm and wind damage reports filed for Ocean County from January 1, 1950, to May 31, 2005. From 1950 to 2005, a total of 10 tornadoes touched down in Ocean County (NOAA 2005). Four of these produced major property damage, greater than $2.5 million. These storms were categorized in the low, moderate, significant, and severe intensity ranges of the Fujita Tornado Scale, that is, F-0 or F-1, F-2, and F-3 category tornados, respectively.[a] One F-3 tornado struck on July 21, 1983, but it did not cause any injuries and/or

(a) Tornado wind speeds for the F-0 to F-4 categories are in the following ranges: F-0: 40 to 72 mph; F-1: 73 to 110 mph; F-2: 113 to 157 mph; F-3: 158 to 206 mph; and F-4: 207 to 260 mph (Fujita 1987).

fatalities. Based on statistics for the 30 years from 1954 through 1983 (Ramsdell 2005), the probability of a tornado striking a point in a 1-degree latitude-longitude square at the site is expected to be about 1×10^{-4} per year. Oyster Creek Severe Weather Procedure AG-108, Rev. 4, has been implemented at OCNGS as a guideline to provide the station with items to be considered in the event severe weather is forecasted to impact the area.

In October 2005, coastal New Jersey and much of the coastal Northeast recorded historical record precipitation amounts (NOAA 2005). Torrential rains in the northeastern United States caused extensive flooding in parts of Maine, New Hampshire, Massachusetts, Connecticut, New York, and New Jersey between October 7 and 12. Rainfall amounts of 6 to 10 in. were common in the affected areas. Additional rainfall during October 14 to 16 caused further flooding from New Jersey northward into New England. Totals ranged from 4 to 8 in. in parts of the region, flooding rivers and streams, and placed considerable strain on reservoir and lake dams.

Wind resources are expressed in terms of wind power classes, ranging from Class 1 to Class 7 (Elliott et al. 1986). Each class represents a range of mean wind power density or approximate mean wind speed at specified heights above the ground. Areas along the shoreline of New Jersey, including Ocean County, have fair to good wind power potential. The wind power resource for this part of the State is rated Class 2 and 3. Areas designated Class 3 or greater are suitable for most wind energy applications, whereas Class 2 areas are marginal, and Class 1 areas are generally not suitable for wind power.[a]

Meteorological conditions on the OCNGS site are monitored from the main meteorological tower, which is 120 m tall. Winds (speed and direction) are measured at two levels on the tower (at 10 m and 116 m) and include horizontal wind direction variations. Temperature is measured at three levels: 10 m, 46 m, and 116 m. Atmospheric stability is determined by using the “delta T” method, which determines differences in temperature readings between the 60-m and 10-m levels. Summaries of annual readings recorded from both levels can be found in the OCNGS radiological effluent release reports (AmerGen 2001a, 2002a, 2003b, 2004a, 2005b). Tower measurements taken over a 5-year period, from January 2000 through December 2004, show that winds are predominantly from the west at 4 to 7 mph at the 10-m level and from the west-northwest at 13 to 24 mph at the 116-m level.

Air quality in a given area is a function of the air pollutant emissions (type of pollutant; rate, frequency, and duration; exit conditions; and location of release), atmospheric conditions (climate and meteorology), the area itself (size of airshed and topography of the area), and the

(a) Wind power densities ranging from 0 to 100 W/m^2 at 10 m (above ground) and 0 to 200 W/m^2 at 50 m (NREL 2005).

pollutants transported from outside the area. Air quality within a 31-mi radius of OCNGS is generally considered good, with the exception of the area just north and adjacent to the Atlantic County-designated moderate ozone nonattainment area (1-hr and 8-hr ozone standards) and the area just south of the Monmouth County moderate ozone nonattainment area (8-hr standard). Monmouth County is also a nonattainment area for particulate matter with a mean aerodynamic diameter of less than 2.5 micrometers ($PM_{2.5}$). To the northwest, Warren County (bordering Philadelphia) is designated as a sulfur dioxide nonattainment area. Localized sources include man-made sources of commercial, residential, and transportation-related emissions. Natural sources of windblown dust contribute to temporary increases in particulate air pollution.

The NJDEP has regulatory authority over air quality in nine Air Quality Control Regions (AQCRs) within the State of New Jersey. OCNGS is located in Ocean County, New Jersey, and is within AQCR 6, the Northern Coastal region, which includes Monmouth and Ocean Counties. AQCR 6 is located in central New Jersey and borders the Atlantic Ocean. This region is designated as being in attainment for all criteria pollutants (40 CFR 81.333). OCNGS is located about 20 mi north of the 6600-ac Brigantine Wilderness Area.

The two small emergency diesel generators, EDG1 and EDG2, serving OCNGS are rated at a nominal capacity of approximately 241 and 256 hp, respectively. The generators and associated diesel fuel oil tanks are housed within separate vaults in a reinforced concrete building southwest of the turbine building. The one-story structure is at approximately grade elevation near the eastern bank of the discharge canal. Technical Specification Section 3.7.C, “Gas Turbine Generators,” requires a minimum volume of 14,000 gal of diesel fuel oil in the 15,000-gal fuel oil storage tank. The diesel generators are used for emergency backup power and provide a standby source of electric power for equipment required for mitigation of the consequences of an accident, for safe shutdown, and for maintenance of the station in a safe condition under postulated event and accident scenarios (AmerGen 2003a). The diesel generators are tested with a 1-hr test burn duration performed biweekly under the plant’s “Emergency Diesel Generator Load Test” procedure (Oyster Creek Procedure 636.4.013). The EDG1 and EDG2 units have certificates to operate under the New Jersey Air Pollution Control Act (Appendix E). This would apply to operations during emergency situations, routine maintenance, and routine exercising (e.g., test firing the engine for one hour every other week to ensure reliability).

There is also a main forced-draft heating boiler (Unit No. 1, SHB001) fired with No. 2 fuel oil and one auxiliary boiler (Unit No. 2, SHB002). Unit No. 1 is used primarily for space heating for the plant, while the Unit No. 2 boiler is currently designated as a backup to Unit No. 1. Unit No. 2 was at one time used as an evaporator boiler. Unit No. 1 is rated at 350 hp, while the backup Unit No. 2 is rated at 1550 hp. Both units are permitted to operate under the New Jersey Air Pollution Control Act (Appendix E).

There are two fire pond diesel engines each dedicated to drive two separate emergency fire water pumps. The diesel engines are both rated at 300 hp (one at 1800 rpm and the other at 1920 rpm) and are connected to two vertical shaft centrifugal main pumps (fired biweekly). The pumps have a water spray capacity of 2000 gpm and have the capability of delivering 2250 gpm. Each engine has its own fuel supply located adjacent to a metal pump house. The pump house contains only the fire and pond pumps and their associated control equipment. The fire pumps are arranged to start automatically if the pressure drops due to a large water demand. Either pump can be manually started from the control room or at the pump house. Two 400-gpm-capacity automatic electric pond pumps maintain pressure on the fire system. These pumps and associated tanks constitute an emergency supply when the primary water supply is not available. All units are permitted to operate under the New Jersey Air Pollution Control Act (Appendix E).

Maintenance tests for each generator are conducted as needed and last 24 hours. Twenty-four-hour endurance burns are run on a staggered test schedule, once every 18 months. Under the air pollution rules and regulations of the NJDEP, Part 2, R 336.1212 (insignificant activities exemptions), emergency diesel generators meeting certain operating criteria are exempt from State operating permit requirements. The rules define emergency power-generating units as stationary internal combustion engines that operate as a mechanical or electrical power source only when the usual supply of power is unavailable. These sources are provided a permit exemption if their annual emissions are less than significance levels as defined in R 336.1119. This would apply to operations during emergency situations, routine maintenance, and routine exercising (e.g., test firing the engine for one hour a week to ensure reliability). Since all of the emergency diesel generators operate for a small number of test hours per year, emissions from these sources are not regulated under New Jersey’s Permit Operating Program. In addition to the emergency diesel generators, the three No. 2 diesel-oil-fired boilers are used for evaporator heating, plant space heating, and feedwater purification. Two units are rated at 690 hp and the third at 750 hp. All three units are permitted to operate under the New Jersey Air Pollution Control Act (Appendix E).

2.2.5 Aquatic Resources

OCNGS is located approximately 2.5 mi west of Barnegat Bay, a protected estuary along the central New Jersey coast, and is bounded to the north by the South Branch of the Forked River and to the south by Oyster Creek. Cooling water is withdrawn from the South Branch of the Forked River and discharged into Oyster Creek, which drains into Barnegat Bay.

Prior to the construction of OCNGS, the South Branch of the Forked River and Oyster Creek were low-salinity systems that experienced minimal tidal intrusions from Barnegat Bay. During plant construction, the river and creek were dredged and widened to accommodate OCNGS cooling-water requirements; most of the natural aquatic communities that occurred within these portions of the river and creek were destroyed. These modifications also reversed the direction of the South Branch of the Forked River, with water now flowing west through the power plant cooling system rather than east into Barnegat Bay. As a result, the South Branch of the Forked River and Oyster Creek are now more similar physically and ecologically to Barnegat Bay than they were prior to OCNGS construction (Kennish et al. 1984; BBNEP 2001).

The most detailed account of the physical, chemical, and biological baselines associated with the Forked River, Oyster Creek, and Barnegat Bay before, during, and after construction is available in *Ecology of Barnegat Bay, New Jersey* (Kennish and Lutz 1984); references to specific chapters of the book are provided in this section. In support of requirements in CWA Sections 316(a) and 316(b), a single demonstration study was conducted between 1965 and 1977. This demonstration study included qualitative comparisons of preoperational and operational conditions, thermal plume mapping, spatial comparisons of water quality and biotic correlations between areas near the plant and reference locations, and estimates of biotic losses relative to impingement, entrainment, and thermal impact (Summers et al. 1989; AmerGen 2005a). This demonstration study was subsequently reviewed by Versar, Inc., under contract to the NJDEP, and a final report was issued in 1989 (Summers et al. 1989). After designation of Barnegat Bay as a National Estuary Program site in July 1995, a series of documents was prepared that characterized the bay and developed conservation, management, and monitoring plans for the estuary and its watershed (BBNEP 2001, 2002, 2003).

2.2.5.1 General Characteristics of Aquatic Systems near OCNGS

Barnegat Bay is a shallow, lagoon-type estuary that is separated from the Atlantic Ocean by a nearly contiguous barrier island complex (Chizmadia et al. 1984; BBNEP 2001). The bay is approximately 43 mi long and 3 to 9 mi wide, with a depth of 3 to 23 ft; the greatest depths are associated with the Intracoastal Waterway, a dredged channel running parallel to the U.S. eastern seaboard (Chizmadia et al. 1984; BBNEP 2002). The total volume of water in the bay is estimated to be 60 billion gal (Guo et al. 2004). The estuary is bordered by the mainland to the west, Point Pleasant and Bay Head to the north, barrier islands to the east, and Manahawkin Causeway to the south. Freshwater enters the bay from numerous streams, including, from north to south, Manasquan River and Canal, Metedeconk River, Kettle Creek, Toms River, Cedar Creek, Stout Creek, Forked River, and Oyster Creek (Chizmadia et al. 1984). Seawater enters the bay from the north through the Point Pleasant Canal via Manasquan Inlet, and from the south through the Little Egg Inlet. There is also a connection between the Atlantic Ocean and Barnegat Bay through Barnegat Inlet, a narrow navigable passage through the barrier islands located to the east southeast of Oyster Creek. Over the years the configuration of the Barnegat Inlet jetty system and the entrance channel have undergone extensive modifications by the USACE. A major program was initiated in 1988 to realign the south jetty and dredge accumulated sediments from the channel (NRC 2005b).

Because of the limited connection of Barnegat Bay to the Atlantic Ocean, tides in the bay are attenuated relative to the open ocean, and complete turnover of water within the bay is estimated to occur every 96 tidal cycles, with 1 tidal cycle completed every 12.7 hr (Chizmadia et al. 1984). This agrees with recent work by Guo et al. (2004), who estimated the average annual flushing time of Barnegat Bay to be as long as 49 days. Water salinity generally ranges from 11 to 32 parts per thousand (ppt); the highest salinity is associated with the inlets, and the lowest is along the western shoreline near the mouths of various rivers and creeks. Water temperature in Barnegat Bay ranges from an average of 35 °F in winter to 75 °F in summer (Chizmadia et al. 1984; BBNEP 2001).

The sediments of Barnegat Bay are typical of a shallow estuary. Substrate in central portions of the bay is composed primarily of fine to medium sand, with muddier sand present closer to the western shore. The substrate in intertidal areas adjacent to the mouths of the Forked River and Oyster Creek is primarily sandy mud (Chizmadia et al. 1984). The barrier islands and mainland shores of Barnegat Bay support a network of coastal wetlands and salt marshes that represent important habitats for juvenile fish and invertebrates (BBNEP 2001). In recent years, concern has been raised regarding the loss of salt marsh habitat along the eastern seaboard (Hartig and Gornitz 2001; GLCF 2005). Some causes of the observed losses are not known; they are assumed, however, to be a combination of sea level rise and hydrological changes that result in an inadequate supply of sediment required for marsh maintenance (Hartig and Gornitz 2001).

Because Barnegat Bay is a shallow, protected estuary with limited tidal flushing, it is particularly susceptible to natural and anthropogenic impacts. In response to growing concerns about these impacts, the New Jersey legislature passed an act in 1987 requiring a comprehensive study of the nature and extent of anthropogenic impacts on the bay and watershed (BBNEP 2002). The result was a series of publications describing the current conditions of the bay, recommendations for managing the resources, and a watershed management plan (BBNEP 2002). After acceptance of Barnegat Bay into the EPA's U.S. National Estuary Program in 1995, additional technical and guidance documents were developed, including the Barnegat Bay Estuary Program Characterization Report (BBNEP 2001) and the Final Comprehensive Conservation Management Plan (BBNEP 2002) that identified the following concerns for Barnegat Bay and its watershed as "priority problems":

- Degraded water quality over extensive areas of the bay;

- Declines in fish and shellfish populations due to disease, reproductive failure, or mortality;

- Changes in abundance, diversity, and distribution of important estuarine organisms;

- Loss of submerged aquatic vegetation (SAV) (e.g., eelgrass beds), wetlands, and coastal salt marshes;

- Closure of shellfish beds due to chemical or microbial contamination; and

- Outbreaks of human disease associated with swimming in contaminated waters or eating contaminated fish or shellfish.

Federal, State, and local agencies have worked collaboratively to define and address the above issues since Barnegat Bay was included in the National Estuary Program.

2.2.5.2 Chemical Contaminants in Aquatic Systems near OCNGS

According to BBNEP (2001), several classes of toxic chemicals are often present in urbanized estuaries at concentrations that could result in adverse impacts on important aquatic resources. Chemicals of potential concern include halogenated hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), heavy metals, and pesticides and their degradation products (e.g., dichloro-diphenyl-trichloroethane [DDT], dichloro-diphenyl-dichloroethylene [DDE], and dichloro-diphenyl-dichloroethane [DDD]). Although there is no major industrial activity within the watershed except for OCNGS, there are numerous nonpoint sources within the watershed that could influence the water or sediment quality of Barnegat Bay. These sources include stormwater discharges, river runoff, deposition of contaminants from the atmosphere, and contamination related to recreational and commercial boating activities. In an evaluation of particle-associated contaminants in Barnegat Bay-Little Egg Harbor, Moser and Bopp (2001), concluded that although the concentrations of metal contaminants have been decreasing since 1970, there are still locations where concentrations are elevated relative to background. A comparison of metal concentrations in sediment samples reported in Moser and Bopp (2001), with threshold effect levels (TELs) and probable effect levels (PELs) summarized by the National Oceanic and Atmospheric Administration (NOAA) (1999), indicates that cadmium, chromium, nickel, lead, and zinc generally exceed TEL levels, which suggests that the potential for adverse impacts exists. Sediment sample data showed a relatively similar distribution of concentrations from approximately Kettle Creek south to the Oyster Creek study area, with the highest metal concentrations associated with samples from marinas. There is no evidence that the surficial sediments near OCNGS contain higher concentrations of trace metals than other areas within the estuary. Total PAH concentrations in sediment samples collected near OCNGS (Moser and Bopp 2001) are well below sediment TEL criteria, suggesting a small potential for adverse impacts. The highest PAH concentrations appear to be associated with marinas.

OCNGS is considered the largest point source of pollution in the Barnegat Bay system. The plant contributes biocides (primarily chlorine and chloramine products) and, prior to the late

1980s when operational practices at the OCNGS essentially ended controlled releases of liquid radioactive waste discharges, low levels of radioactive isotopes, to Oyster Creek, and ultimately to Barnegat Bay. Biocide usage is restricted by the current NJPDES permit for the facility, which also requires the measurement of TSS, pH, petroleum hydrocarbons, total organic carbon, and water temperature at various operational locations. During the development of this SEIS, the NRC staff reviewed NJDEP inspection reports from November 1999 to April 2005; OCNGS annual environmental monitoring reports to the NRC from 1999 to 2004; and acute toxicological testing of three permitted NJPDES outfalls (DSN001, DSN002, and DSN004) from 2000 to 2004. NJDEP inspection reports did not identify any compliance issues, and acute toxicity was not observed in the 96-hr test using mysid shrimp (Mysidopsis bahia) to evaluate a dilution series of representative effluent samples from these outfalls.

2.2.5.3 Important Fish and Shellfish near OCNGS

During a 3-year study from September 1975 to August 1978, 108 species of fish representing 57 families were collected in western Barnegat Bay from the mouth of Cedar Creek to the mouth of Double Creek (Tatham et al. 1984). Of the 108 species collected, 20 were identified as resident species, 34 were considered warmwater migrants, 12 were coolwater migrants, 35 were classified as local marine strays, and 7 were considered freshwater strays (Tatham et al. 1984). Five species accounted for 90 percent of the catch, including three resident species and two warmwater migrant species (Table 2-2). Shellfish, shrimp, and other species in Barnegat Bay that are commercially, recreationally, or ecologically important include the hard clam (*Mercenaria mercenaria)*, blue crab (*Callinectes sapidus*), sand shrimp (*Crangon septemspinosa*), opossum shrimp (*Neomysis integer*), and a variety of other crab, marine snails, and sea stars (Table 2-3).

The Fishery Conservation and Management Act (FMCA) of 1976, as amended by the Sustainable Fisheries Act in 1996, requires Essential Fish Habitat (EFH) consultations with the NMFS for species with designated EFH identified by regional fishery management councils. Because EFH designations for Barnegat Bay encompass the entire bay and adjacent ocean habitats, the list of species addressed in the EFH Assessment (Appendix E) includes additional species that are less common in Barnegat Bay when compared with previous studies.

What follows is a brief summary of life history characteristics of some fish and shellfish considered to be commercially, recreationally, or ecologically important. This list includes species that represent the most abundant and important forage and piscivorous fishes in Barnegat Bay, as defined by Tatham et al. (1984); the two species of shellfish that are commercially, recreationally, and ecologically important (hard clam and blue crab); and a brief description of the shrimp species most common to the bay. Included in this discussion is an overview of shipworms, which are wood-boring bivalves that are represented by both native and introduced species.

Table 2-2. Resident, Seasonally Abundant, and Ecologically Important Fish in Barnegat Bay, 1975 to 1978

Scientific Name[a]	Common Name	Classification	Use of Estuary[b]
Anchoa mitchilli[c]	bay anchovy	warmwater migrant	Sp, SN
Anguilla rostrata	American eel	resident	SN
Apeltes quadracus	four-spined stickleback	resident	Sp, SN
Brevoortia tyrannus	Atlantic menhaden	warmwater migrant	SN
Chasmodes bosquianus	striped blenny	resident	Sp, SN
Cynoscion regalis	weakfish	warmwater migrant	SN
Cyprinodon variegatus	sheepshead minnow	resident	Sp, SN
Fundulus heteroclitus	common mummichog	resident	Sp, SN
Fundulus majalis	striped mummichog	resident	Sp, SN
Gobiosoma bosci	naked goby	resident	Sp, SN
Hippocampus erectus	seahorse	resident	Sp, SN
Hypsoblennius hentzi	feather blenny	resident	Sp, SN
Leiostomus xanthurus[c]	spot	warmwater migrant	SN
Lucania parva	rainwater killifish	resident	Sp, SN
Menidia beryllina	inland silverside	resident	Sp, SN
Menidia menidia[c]	Atlantic silverside	resident	Sp, SN
Morone americana	white perch	resident	Sp, SN
Morone saxatilis	striped bass	local marine stray	–
Opsanus tau	oyster toadfish	resident	Sp, SN
Ophidion marginatum	striped cusk-eel	resident	MN
Pomatomus saltatrix	bluefish	warmwater migrant	SN
Pseudopleuronectes americanus[c]	winter flounder	resident	Sp, SN
Syngnathus fuscus	northern pipefish	resident	Sp, SN
Tautoga onitis	tautog	resident	Sp, SN
Tautogolabrus adspersus	cunner	resident	Sp, SN
Trinectes maculatus	hogchoker	resident	Sp, SN

(a) Species in bold text were identified in past studies as commercially, recreationally, or ecologically important.
(b) Sp = uses estuary for spawning; SN = significant use of estuary as nursery area; MN = minor use of estuary for spawning; – = no regular use of estuary.
(c) Species collectively accounting for 90 percent of the catch from 1975 to 1978.
Source: Adapted from Tatham et al. 1984

Table 2-3. Invertebrate Species in Barnegat Bay That Are Commercially, Recreationally, and Ecologically Important

Scientific Name[a]	Common Name	Importance
Asterias forbesi	sea star	Predator on juvenile hard clam
Bankia gouldi	shipworm	Destruction of wooden structures
Busycon canaliculatum	channeled whelk	Predator on juvenile hard clam
Busycon carica	knobbed whelk	Predator on juvenile hard clam
Callinectes sapidus	blue crab	Recreational and commercial harvest
Cancer irroratus	rock crab	Predator on juvenile hard clam
Carcinus maenas	green crab	Predator on juvenile hard clam
Crangon septemspinosa	sand shrimp	Predator on winter flounder eggs, prey item for fish, recreational/ commercial harvest
Eupleura caudata	thick-lipped oyster drill	Predator on juvenile hard clam
Limulus polyphemus	horseshoe crab	Commercial harvest, predator on juvenile hard clam
Lunatia heros	northern moon snail	Predator on juvenile hard clam
Mercenaria mercenaria	hard clam	Recreational and commercial harvest
Neomysis americana	mysid shrimp	Contributor to food web
Neomysis integer	opossum shrimp	Contributor to food web
Polinices duplicatus	lobed moon shell	Predator on juvenile hard clam
Teredo navalis	shipworm	Destruction of wooden structures

(a) Species in bold text are known to be affected by OCNGS operations.
Source: Kennish and Lutz 1984.

Bay Anchovy

The bay anchovy (*Anchoa mitchilli*, family Engraulidae) was one of the most abundant species observed in the 1970s by Tatham et al. (1984). Considered a warmwater migrant, this species uses the estuary for spawning and as a nursery ground (Table 2-2). There is no recreational or commercial use for this species. The bay anchovy occurs along both the Atlantic and Gulf of Mexico coastlines and is abundant off the coasts of Massachusetts, Rhode Island, New York, and New Jersey (FWS/DOI/USACE 1989a). Adults seldom exceed 9 cm in length and are found in a variety of habitats, including shallow to moderately deep offshore waters, nearshore waters off sandy beaches, open bays and muddy coves, and river mouths. Mysid shrimp are the principal food for adults; copepods are the principal food for larvae and juveniles (Bigelow and Schroeder 1953; FWS/DOI/USACE 1989a). Anchovies are ecologically important because they are a primary food source for a variety of fish and birds and represent a key component of regional food webs (FWS/DOI/USACE 1989a). Studies conducted by Morgan et al. (1995) suggest that the bay anchovy demonstrates little genetic variation and no discernable stock structure, probably due to the enormous population size and the movement and mixing of various stocks. In the mid-Atlantic region, spawning generally occurs where water temperatures are at least 54 °F, but it may occur at temperatures as low as 48 °F. Adult bay anchovies appear to exhibit a relatively high tolerance to fluctuations in both temperature and salinity, and have demonstrated a tolerance to high water temperatures associated with thermal discharges (FWS/DOI/USACE 1989a). The primary anthropogenic stressors impacting the bay anchovy are habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, and eutrophication associated with urban development (Buchsbaum et al. 2005)

Recent population trends for the bay anchovy are not available for Barnegat Bay. Fishery statistics for this species are not available from the NMFS's Northeast Fisheries Science Center (NMFS 2005a). Commercial landing data for the State of New Jersey also are not available from the NMFS's Office of Science and Technology (NMFS 2005b). The Mid-Atlantic Fishery Management Council (MAFMC) has not identified the bay anchovy as a managed species; therefore, no EFH has been designated for this species.

American Eel

The American eel (*Anguilla rostrata*, family Anguillidae) is a catadromous species with a range extending from Greenland south along the Atlantic coast of Canada and the United States to Panama (FishBase 2005). Eels are used as bait by both commercial and recreational fishermen. Eels spend most of their lives in freshwater or estuarine environments and return to the sea to spawn. The American eel is a resident species in Barnegat Bay that utilizes the estuary as a nursery area (Table 2-2).

American eels typically grow to a length of 122 cm and to a weight of approximately 7.3 kg; they mature at 8 to 24 years (Bigelow and Schroeder 1953). Eels are extremely resilient and can survive in a variety of freshwater, estuarine, and marine habitats (FWS/DOI/USACE 1987). This catadromous species spends most of its time in freshwater systems. The primary anthropogenic stressors on American eels are physical habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, eutrophication associated with urban development, and sediment delivery changes in nearshore systems based on activities in the watershed (Buchsbaum et al. 2005). It is possible that the dam on Oyster Creek created during construction of OCNGS and used to impound water for fire fighting has restricted the upstream migration of American eels. The impact of this structure cannot be determined because this species was not evaluated during the 316(b) determination (EA 1986), and there are no current estimates of American eel abundance in Oyster Creek. It is likely, however, that the low water dam is not a significant barrier to upstream migration of elvers. The species was reported as present in Oyster Creek and the South Branch of the Forked River in the OCNGS Final FES (AEC 1974).

Current population abundances of American eels in Barnegat Bay are not known. Commercial landings in New Jersey were less than 50 metric tons from 1950 to 1965, then gradually increased to approximately 100 metric tons until about 1975, when the fishery again declined. New Jersey commercial landings peaked in 1984 at nearly 250 metric tons and have gradually decreased since. The commercial harvest in 2004 was slightly less than 55 metric tons and reflects harvests typical of the 1950s and early 1960s (NMFS 2005b). Eels are challenging to manage because they occupy a variety of habitats that often cross species management jurisdictions (ASMFC 2005f). The species is currently under status review to determine its eligibility for listing under the Endangered Species Act. The Atlantic States Marine Fishery Council (ASMFC) has developed a fishery management plan for this species, but EFH has not been identified in Barnegat Bay.

Four-spined Stickleback

The four-spined stickleback (*Apeltes quadracus*, family Gasterosteidae) is a common fish along the U.S. Atlantic Coast. It represents one of the most abundant species observed in Barnegat Bay (Tatham et al. 1984) and uses the estuary for spawning and as a nursery area for young (Table 2-2). The four-spined stickleback is a small fish, ranging in size from approximately 3 to 6 cm. Commercial use of this fish appears to be related to use in private and public aquariums (FishBase 2005). This species is common in salt marshes, is generally found in nearshore areas, and is tolerant of freshwater. Four-spined sticklebacks spawn from early spring to mid-summer, and eggs tend to sink and stick together in clumps on the bottom, where they are guarded by the female during the incubation period. Four-spined sticklebacks are an important part of nearshore marine and estuarine food webs and are eaten by larger fish. Their chief food appears to be copepods and small crustaceans (Bigelow and Schroeder 1953). Four-spined sticklebacks are considered to be highly resilient to a variety of impacts, with a minimum population doubling time of less than 15 months (FishBase 2005). The primary anthropogenic stressors impacting four-spined sticklebacks include physical habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, and eutrophication associated with urban development (Buchsbaum et al. 2005).

Recent population trends for the four-spined stickleback are not available for Barnegat Bay. Fishery statistics for this species are not available from the NMFS (2005a). Commercial landing data for the State of New Jersey were also not available from the NMFS (2005b). The MAFMC has not identified the four-spined stickleback as a managed species; therefore, no EFH has been designated for this species.

Atlantic Menhaden

Atlantic menhaden (*Brevoortia tyrannus*, family Clupeidae) are common to estuaries and coastal waters, with a range extending from Nova Scotia to Florida. The commercial harvest of this species represents a significant source of income along the Atlantic Coast (ASMFC 2005e). Adult menhaden average about 30 to 38 cm in length, and they weigh between 300 and 450 g (FWS/DOI/USACE 1989e). The primary food of adult and juvenile fish is plankton, which they obtain with highly specialized gill rakers (Bigelow and Schroeder 1953). Menhaden represent an important food source for a variety of larger fish, including the striped bass, bluefish, and weakfish. The Atlantic menhaden, a warmwater migrant, makes significant use of Barnegat Bay as a nursery area (Table 2-2). Menhaden have a large geographic range and exhibit a high tolerance for variable temperature and salinity; they have been found in water ranging in salinity from 1 to 36 ppt and at temperatures ranging from approximately 41 to 95 °F. They appear to have age-specific salinity and temperature requirements, and these parameters affect (1) the tolerance of the species to other environmental stressors, (2) larval development, (3) growth, and (4) overall activity (FWS/DOI/USACE 1989e). The primary anthropogenic stressors to this species are habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, eutrophication from contaminant runoff associated with urban development, and possibly habitat changes associated with long-term climatic changes (Buchsbaum et al. 2005).

Recent population trends for menhaden are not available for Barnegat Bay, but statistics on commercial catches in the waters of New Jersey from 1950 to 2003 are available (NMFS 2005b). The highest recorded landings of menhaden from New Jersey occurred from about 1950 to 1963, when landings often exceeded 100,000 metric tons. The fishery sharply declined from about 1963 to 1966, briefly rebounded in the 1970s, and has averaged less than 9000 metric tons from 1982 to 2003 (NMFS 2005b). Overfishing is believed to explain the declines observed in the 1960s, but the reason for the recent trends is not well understood (ASMFC 2005e). At present, menhaden are not identified as a managed species by the MAFMC (2005); therefore, no EFH has been designated for this species. The ASMFC (2005c) does not consider the menhaden stock overfished. This may be because the fishing mortality rate target has been met in recent years.

Weakfish

The weakfish (*Cynoscion regalis*, family Sciaenidae) is one of the most abundant fishes in the nearshore and offshore waters of the Atlantic Coast, with a range extending from Massachusetts to Florida (FWS/DOI/USACE 1989d). The weakfish, a warmwater migrant, makes significant use of the Barnegat Bay estuary as a nursery ground (Table 2-2). Weakfish represent a valuable recreational and commercial resource and have supported fisheries along the Atlantic Coast since the 1800s (ASMFC 2005d).

Weakfish migrate from offshore wintering grounds to nearshore areas during the spring when the water warms, and spawn shortly after completing the nearshore migration. Weakfish move in schools and are usually found a few feet below the surface of the water. Growth is rapid, and most weakfish spawn at the end of their first year of life. Most weakfish range in size from 35 to 66 cm and weigh between 0.5 to 2.7 kg (Bigelow and Schroeder 1953). Weakfish feed at night; their primary food includes penaeid shrimp, anchovies, and small fish. They exhibit a relatively high tolerance for temperature and salinity extremes and have been found in water at temperatures ranging from approximately 48 to 88 °F and salinity ranging from 0.1 to 32.3 ppt (FWS/DOI/USACE 1989d).

Recent population trends for the weakfish are not available for Barnegat Bay, but commercial catch statistics for the State of New Jersey from 1950 to 2003 show that the largest commercial landings occurred from about 1970 to 1987, when catches routinely exceeded 1000 metric tons. The largest recorded commercial catch (nearly 3000 metric tons) occurred in 1979. Since that time, the landings for New Jersey have steadily declined and now represent the lowest catches observed since 1950 (NMFS 2005b). The MAFMC (2005) does not identify weakfish as a managed species; the ASMFC, however, has developed a management plan. The ASMFC considers the weakfish fishery depleted and overfished and believes the stock rebuilding process will take several years (ASMFC 2005c). There is no designated EFH for weakfish in Barnegat Bay.

Spot

Spot (*Leiostomus xanthurus*, family Sciaenidae) is a common species along the U.S. Atlantic Coast, with a range extending from the Gulf of Maine to Florida. They are most abundant from Chesapeake Bay south to South Carolina and are known to migrate seasonally, entering bays and estuaries in the spring and moving offshore later in the summer to spawn (ASMFC 2005a). Spot are important to both commercial and recreational fishermen in the mid-Atlantic region and are an important part of nearshore food webs as both predator and prey. Spot, one of the most abundant resident species in Barnegat Bay, make significant use of the estuary as a nursery area (Table 2-2). Spot grow to a length of 33 to 36 cm and reach sexual maturity at 2 to 3 years of age, with a maximum lifespan of about 5 years. Juvenile spot feed primarily on plankton, copepods, mysids, and amphipods. Larger individuals feed on bivalves, polychaetes, and other infaunal species. Spot are an important food source for a variety of birds and fish (FWS/DOI/USACE 1989b). Spot are highly tolerant of a wide range of temperature and salinity conditions and have been found in water at temperatures ranging from 46 to 88 °F and salinity ranging from 0 to 60 ppt (FWS/DOI/USACE 1989b).

Recent population trends for the spot are not available for Barnegat Bay. Fishery statistics for this species are not available from the NMFS (NMFS 2005a), nor is it identified as a managed species by the MAFMC (MAFMC 2005). In 1987, the ASMFC adopted a fishery management plan for spot, and at present, participating States include Delaware south to Florida (ASMFC 2005a). Commercial landing data for the State of New Jersey from 1950 to 2003 showed that the largest harvests occurred between 1951 and 1957 (NMFS 2005b). The highest recorded landing was 140.6 metric tons in 1952. From 1993 to 2003, commercial landings have ranged from 0.5 to 14.2 metric tons with no apparent trend (NMFS 2005b). The ASMFC (2005a) concluded that the current condition of the stock is unknown, and there are no rebuilding goals in the fishery management plan for this species. There is no designated EFH for spot in Barnegat Bay.

Atlantic Silverside

The Atlantic silverside (*Menidia menidia*, family Atherinidae) is a small, schooling fish common to bays, estuaries, and salt marshes along the northern Atlantic Coast, with a geographic range extending from New Brunswick and Nova Scotia south to Florida (FWS/DOI/USACE 1983a). Commercial use of this fish appears to be related to aquarium supply and for use in aquatic toxicological testing (FishBase 2005). The Atlantic silverside, one of the most abundant species in Barnegat Bay, uses the estuary for spawning and as a nursery area for young fish (Table 2-2). Silversides grow to a length of approximately 14 cm. Silversides are an important part of the marine food web and are an important food source for a variety of larger fish, including bluefish (*Pomatomus saltatrix*), Atlantic mackerel (*Scomber scombrus*), and striped bass (*Morone saxatilis*) (FWS/DOI/USACE 1983a), and for piscivorous birds (Burger 2005). Silversides reach reproductive maturity at 1 year and are believed to live only 1 or 2 years. Spawning generally occurs during the day at high tide on a semilunar cycle in water temperatures of 48 to 54 °F. Eggs are adhesive and attach to available vegetation; larvae are planktonic and tend to remain in the spawning area. Egg production of the Atlantic silverside is estimated to range from 4725 to 13,525 eggs per female (FWS/DOI/USACE 1983a). Juvenile and adult silversides are opportunistic feeders; prey items include copepods, mysids, amphipods, cladocerans, fish eggs, squid, polychaetes, planktonic larvae, and a variety of algae, diatoms, and detritus (Bigelow and Schroeder 1953). Silversides exhibit a high tolerance to temperature and can survive in temperatures between 37 to 88 °F. Juveniles prefer a temperature range of 64 to 77 °F, and adults are tolerant of salinity ranging from freshwater to 37.8 ppt. The primary anthropogenic stressors impacting silversides are habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, and eutrophication associated with urban development (Buchsbaum et al. 2005).

Recent population trends for the Atlantic silverside are not available for Barnegat Bay. Fishery statistics for this species are not available from the NMFS (2005a). Commercial landing data for the State of New Jersey also are not available from the NMFS (2005b). The MAFMC has not identified the Atlantic Silverside as a managed species; therefore, no EFH has been designated for this species.

Striped Bass

The striped bass (*Morone saxatilis*, family Moronidae) has represented one of the most important commercial fisheries on the Atlantic Coast for centuries, and the fishery has been regulated since Europeans settled in North America. Striped bass typically spend the majority of their lives in shallow, nearshore waters or the ocean, and may live 30 years. The striped bass, considered a local marine stray, does not utilize Barnegat Bay for either spawning or as a nursery area (Tatham et al. 1984). More recent assessments to determine utilization of Barnegat Bay by striped bass have not been conducted. Sexual maturity is reached at three years for males and six for females. Spawning occurs either in freshwater or in estuaries receiving riverine input. Females may produce up to 500,000 eggs (ASMFC 2005g). Juvenile striped bass less than 30 cm long generally weigh less than 0.5 kg, 91-cm-long specimens typically weigh 9 kg, and those with a length greater than 152 cm may weigh more than 23 kg (Bigelow and Schroeder 1953). Larval striped bass feed primarily on planktonic invertebrates; adults feed primarily on small schooling fish such as herring and shad. Bass may be preyed upon by larger fish and are also susceptible to parasitism by nematodes (FWS/DOI/USACE 1989f).

Temperature changes appear to affect striped bass reproduction; a sudden rise may trigger spawning, a sudden drop its cessation. Spawning generally occurs in a temperature range of 57 to 75 °F. Normal development and hatching of striped bass eggs require dissolved oxygen levels of at least three to five mg/L, and the apparent minimum dissolved oxygen level for adults appears to be three mg/L. Optimal salinity is approximately zero to three ppt for eggs and larvae, and as the larvae grow into adults, their tolerance for higher salinity increases (FWS/DOI/USACE 1989f).

The primary anthropogenic stressors of striped bass are habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, eutrophication and contaminant runoff associated with urban development, and sediment delivery changes in nearshore systems based on activities in the watershed (Buchsbaum et al. 2005).

The current population size of striped bass in Barnegat Bay is not known, but it was not considered a dominant species by Tatham et al. (1984). Commercial harvest data for striped bass caught in New Jersey are available from 1950 to 1995 (NMFS 2005b). During that time, commercial landings fluctuated greatly, ranging from 0.1 to 452 metric tons. Landings of more than 200 metric tons occurred in 1952, 1962 to 1965, 1968, 1973, and 1974. Landings declined dramatically after 1974, and were 0.2 metric ton or less until 1987. Since that time, resource management actions initiated by many coastal states have allowed the populations to rebound, and the fishery is once again healthy and considered restored (ASMFC 2005g; NMFS 2005a). However, MAFMC has not identified this striped bass as a federally managed species; therefore, no EFH has been designated for this species.

Bluefish

The bluefish (*Pomatomus saltatrix*, family Pomatomidae) is a migratory, pelagic species that is found throughout most of the world in temperate coastal waters (ASMFC 2005h). These fish can live up to 12 years, reach a maximum size of approximately 106 cm, and can weigh more than 11 kg (Bigelow and Schroeder 1953). The bluefish is an important recreational and commercial fish along the Atlantic Coast, and is a warmwater migrant in Barnegat Bay that utilizes the estuary as a significant nursery area (Tatham et al. 1984). In the mid-Atlantic region, spawning occurs during the summer in waters over the continental shelf, and adults that have completed spawning move inshore to the coast of New Jersey and occupy bays, estuaries, and inlets (FWS/DOI/USACE 1989g). Bluefish are voracious predators that feed on a large variety of fish and invertebrates. In the mid-Atlantic region, bluefish spawn in water at temperatures ranging from 63 to 75 °F and at salinities of approximately 30 to 32 ppt. Larvae appear to require a temperature of at least 50 °F to survive. The primary anthropogenic stressors of bluefish are habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, and eutrophication associated with urban development (Buchsbaum et al. 2005).

Recent bluefish population data are not available for Barnegat Bay, but commercial landing data for New Jersey are available from 1950 to 2003 (NMFS 2005b). Bluefish landings from 1950 to 1957 exceeded 400 metric tons, then declined to 41.2 metric tons in 1958. Landings gradually increased, peaking at 1362 metric tons in 1986. Landings have gradually declined since that time to the present levels of between 400 and 600 metric tons from 1995 to 2003. Bluefish are managed under a fishery management plan developed by the MAFMC and the ASMFC. Management measures include bag limits in the recreational fishery and commercial quotas. The stock is rebuilding, and full recovery is predicted by 2008 (ASMFC 2005h). EFH has been designated for bluefish in Barnegat Bay.

Winter Flounder

Winter flounder (*Pseudopleuronectes americanus*, family Pleuronectidae) are common in estuaries and nearshore waters along the Atlantic Coast from Newfoundland to Chesapeake Bay and represent an important commercial and recreational fishery resource. Winter flounder, one of the most abundant species in Barnegat Bay, is a resident species that uses the Barnegat Bay estuary as spawning and nursery grounds (Table 2-2). This right-eyed species (eyes on the right side of the body) grows to a length of 30 to 38 cm and generally weighs between 0.5 and 0.9 kg (Bigelow and Schroeder 1953). The preferred substrate is muddy sand. In the mid-Atlantic region, females mature at the age of 2 or 3 years and produce between 500,000 and 1.5 million eggs per spawn (ASMFC 2005b). Winter flounder are migratory and tend to move from nearshore areas to deeper water during the summer months, returning to nearshore areas in the late fall and winter to spawn. Winter flounder tend to return to their natal estuaries to spawn. The primary predators of adult winter flounder are striped bass, and bluefish. Larval and juvenile winter flounder are often eaten by birds and burrowing shrimp. Winter flounder have a high tolerance for a broad range of temperature and salinity conditions and are commonly found in water at temperatures ranging from 32 to 77 °F and salinities ranging from 5 to 35 ppt (FWS/DOI/USACE 1989c). The primary anthropogenic stressors of winter flounder are physical habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, eutrophication associated with urban development, and sediment delivery changes in nearshore systems based on activities in the watershed (Buchsbaum et al. 2005).

Recent population trends for the winter flounder are not available for Barnegat Bay. A fisheries management plan exists for this species, and the Northeast Regional Stock Assessment Workshop/Stock Assessment Review Committee (SAW/SARC) concluded in 2003 that the Southern New England/Mid-Atlantic winter flounder stock is overfished, and that overfishing continues to occur (NMFS 2003). This conclusion was confirmed in 2005 by the ASMFC (2005c). Commercial landings for New Jersey from 1950 to 2003 (NMFS 2005a) show a large variation in catch, with a period of high harvest followed by a series of years of decreasing harvest. Over the past 53 years, peak catches (>150 metric tons) occurred in the late 1960s and early 1980s. Catches of less than 50 metric tons have occurred in the 1950s, early 1970s, and late 1990s. From 1999 to 2003, catches have approached or exceeded 250 metric tons with the exception of 2002, when 109.6 metric tons of winter flounder were landed by commercial fishermen working in New Jersey waters (NMFS 2005a). Winter flounder EFH has been designated in Barnegat Bay.

Northern Pipefish

The northern pipefish (*Syngnathus fuscus*, family Syngnathidae) has a large distribution in the western Atlantic Ocean, ranging from the Gulf of St. Lawrence to Florida. This species is common in seagrass beds in bays and estuaries and also frequents freshwater (FishBase 2005). Commercial use of this fish is limited to use in private and public aquariums (FishBase 2005). The northern pipefish, a resident species in Barnegat Bay, makes significant use of the estuary for spawning and also as a nursery area (Table 2-2). Northern pipefish feed primarily on small copepods and amphipods, on fish eggs, and in some cases on very small fish. Breeding occurs during the spring and summer months, and eggs are incubated for approximately 10 days. Young are retained in a brood pouch until their yolk sac has disappeared (Bigelow and Schroeder 1953). The primary anthropogenic stressors affecting northern pipefish are habitat loss, hydrologic changes resulting from water diversion or withdrawal activities, and eutrophication associated with urban development (Buchsbaum et al. 2005).

Recent population trends for the northern pipefish are not available for Barnegat Bay. Fishery statistics for this species are not available from the NMFS (2005a). Commercial landing data for the State of New Jersey also are not available from the NMFS (2005b). The MAFMC has not identified the northern pipfish as a managed species; therefore, no EFH has been designated for this species.

Blue Crab

The blue crab (*Callinectes sapidus*, family Portunidae) is an important commercial and recreational resource along the Atlantic seaboard and is one of the largest fisheries associated with Barnegat Bay. Blue crabs are an important part of marine and estuarine food webs, serving as both prey during early developmental stages and predators as adults on a variety of invertebrates. They are also important detritivores and scavengers (FWS/DOI/USACE 1989h; BBNEP 2001). Blue crabs reach sexual maturity in about two years, and generally live four years or less. Males are capable of mating in more than one season; females mate only once, immediately after their terminal molt. In the mid-Atlantic region, mating generally occurs during the summer, larvae are released into the water and are transported by currents. After settlement to the bottom, juvenile blue crabs molt and grow rapidly and migrate away from high-salinity water into brackish waters, where they mature. Juvenile and adult blue crabs are often associated with eelgrass beds, where they seek cover (BBNEP 2001).

Data on commercial blue crab landings in New Jersey are available for 1950 to 2003 (NMFS 2005b). Landings were variable from about 1950 to 1982, ranging from a low of about 61 metric tons to more than 1000 metric tons from 1973 to 1976. Beginning in about 1982, the landings began to increase and exceeded 2000 metric tons in all but two years. In 1993 and 1995, the New Jersey landings were approximately 3500 metric tons, the largest harvests recorded since 1950 (NMFS 2005b). From 1989 to 1997, blue crab landings in Barnegat Bay represented between 8 and 24 percent of the total blue crab landings in the State of New Jersey. During that time, the value of the resource ranged from $282,000 to $635,000 and represented approximately 9 to 23 percent of the total commercial fishery value for New Jersey. There is also a thriving recreational blue crab fishery in Barnegat Bay, suggesting that the populations of blue crabs are currently sufficient to sustain both commercial and recreational uses. The MAFMC has not identified the blue crab as a managed species; therefore, no EFH has been designated for this species.

Shrimp

A variety of shrimp species is present in Barnegat Bay, including sand shrimp (*Crangon septemspinosa*), grass shrimps (*Palaemonetes vulgaris* and *P. pugio*), opossum shrimp (*Neomysis integer*), and mysid shrimp (*N. americana*). Sand shrimp are commercially and recreationally important as bait and are a primary predator of winter flounder eggs. Grass shrimp are both predators on small benthic fauna and prey items to larger fish. Mysid shrimp represent a valuable food source for recreationally and commercially important finfish (BBNEP 2001). Population estimates for these species are not available for Barnegat Bay, but sand shrimp is the most common species impinged in the OCNGS cooling-water system. No shrimp EFH has been designated in Barnegat Bay.

Hard Clam

The hard clam (*Mercenaria mercenaria*, family Veneridae) represents one of the most important commercial and recreational resources along the Atlantic Coast of the United States. This species is found in intertidal and subtidal waters from the Gulf of St. Lawrence to Texas. It is most abundant from Massachusetts to Virginia (FWS/DOI/USACE 1983b). Hard clams have thick shells and short siphons. The clam ranges in length from 60 to 70 mm; some specimens may exceed 120 mm. The spawning season for hard clams extends from approximately May through August. Temperature is the primary determinant of spawning and is also an important factor in gamete maturation and survival. Clams become sexually mature at two or three years of age, but maturity is determined by size, not age (FWS/DOI/USACE 1983b). Hard clams are filter feeders and obtain food by filtering small plankton from the water column. Because of this and their location in intertidal and subtidal estuaries, they are susceptible to changes in the quality and quantity of their food source (size and species of plankton), changes in salinity and temperature, the presence of contaminants and bacterial pollutants, and the effects of harmful algal blooms. In recent years, declines in clam harvests have been attributed to a variety of environmental factors, including the presence of brown, green, and red algal blooms (*Aureococcus anophagefferens*, *Nannochloris atomus*, and *Alexandrium fundyense*, respectively); degraded quality of the water in nearshore regions; and anthropogenic or other changes that have changed the salinity and temperature regimes in the region (New York SeaGrant 1999; MacKenzie 2003).

The population of hard clams in Barnegat Bay was once quite large but has decreased dramatically in the last three decades. In 1879, the Barnegat Bay hard clam fishery produced 150,000 bushels, and yields of 100,000 bushels were common until the early 1970s (Mackenzie 2003). Since that time, harvests in Barnegat Bay and Great South Bay have dropped dramatically and now represent only a fraction of the historical harvests. Likely reasons for the observed declines include deterioration of water quality, the presence of deleterious plankton blooms, impacts associated with chemical and bacterial contaminants associated with nearshore runoff, and the presence of predators such as blue crabs and starfish (MacKenzie and Pikanowski 1999; MacKenzie 2003). Recent information published by New York SeaGrant (2004) suggests that hard clams are also susceptible to disease from the presence of a single-celled microscopic parasite, currently referred to as "Quahog Parasite Unknown" or QPX. The MAFMC has not identified the hard clam as a managed species; therefore, no EFH has been designated for this species.

Shipworms

Shipworms are highly specialized mollusks of the family Teredinidae. The destructive potential of shipworms has existed as long as wooden ships, piers, bridges, and floating structures have existed. Many shipworm species are protandrous, initially developing as males and changing sex later in life. Spawning in Barnegat Bay occurs from about April to October, and larval settlement occurs between July and December (BBNEP 2001). It is during the settlement phase that the larval shipworm enters wooden substrate; the larvae must encounter a suitable substrate within a short time in order to survive. The optimal conditions for reproduction and survival include water temperatures of 50 to 86 °F and salinities ranging from 10 to 32 ppt. During the winter months, in the absence of warm water, shipworms experience high mortality; the few remaining adults, however, allow the population to continue.

Shipworms have been studied in Barnegat Bay since 1885. Extensive studies of shipworms in the Barnegat Bay estuary were conducted during the early 1970s to better understand the environmental impacts of OCNGS thermal discharges on both resident and introduced shipworm species (Richards et al. 1984). At the time the plant was constructed, there were several marinas along the southern shore of Oyster Creek. Prior to construction and operation of OCNGS, the creek was predominately freshwater, and untreated wooden structures were commonly used for marinas, docks, and other structures. In the late 1960s and early 1970s, many of the boats that moored at the marina had wooden hulls that were not affected by marine fouling organisms, including shipworms, because shipworms cannot survive in freshwater. Thus, vessel owners often economized on antifouling products for their vessels. After startup of OCNGS in 1969, salinity in Oyster Creek became similar to Barnegat Bay, and shipworm habitat was created in the creek, especially in areas influenced by the thermal plume. After establishment of shipworms in Oyster Creek, infestation of the marinas along Oyster Creek by both native and invasive shipworm species was devastating to both the untreated pilings and the wooden hull boats.

Four teredinid species were identified during the 1970s and 1980s: *Bankia gouldi*, *Teredo navalis*, *T. bartschi*, and *T. furcifera*. *B. gouldi* was the dominant species along the western perimeter of Barnegat Bay and had the largest range in the estuary. *T. navalis* was dominant along the eastern perimeter. *T. bartschi* and *T. furcifera* are subtropical species that were introduced and became adapted to the OCNGS thermal discharge during the 1970s and 1980s. From March 1980 to August 1982, Hoagland and Crockett (1980; 1982a,b,c) and Hoagland (1982a, 1982b) conducted a series of studies to evaluate shipworm species composition, distribution, and population dynamics. During these studies, untreated wood panels were deployed at 12 stations in Oyster Creek, the South Branch of the Forked River, and Barnegat Bay to evaluate shipworm impacts, and laboratory studies were conducted to determine the temperature and thermal tolerance levels of various species. These studies indicated that the occurrence of the invasive species *T. bartschi* was confined to Oyster Creek until the summer of 1982, when it was observed in the South Branch of the Forked River. *Toredo navalis* was the most common shipworm in the study area. Shipworms that occurred outside of the OCNGS thermal influence experienced significant dieoff in winter months. Laboratory experiments demonstrated that *T. bartschi* became inactive at temperatures and salinities below 41 °F and 24 ppt, respectively, and that *T. navalis* showed signs of osmotic stress below 10 ppt at 64 °F (Hoagland and Crockett 1982b) but is able to exist at temperatures as low as 39 °F (Hoagland and Crockett 1982c). Experiments also indicated that pediveligers of *T. bartschi* prefer not to settle on wood already containing adults (Hoagland and Crockett 1982a). According to the BBNEP (2001), the introduced species *T. bartschi* and *T. furcifera* are no longer found in the study area. This is probably due to the replacement of untreated wood structures with treated materials that are toxic to shipworms and the use of concrete or other materials in pilings rather than untreated wood.

2.2.5.4 Other Important Aquatic Resources near OCNGS

Submerged Aquatic Vegetation

A variety of macroalgae and vascular plants are present as submerged aquatic vegetation (SAV) in Barnegat Bay, and 116 species of benthic algae were documented by Loveland and Vouglitois(1984), with the dominant species including sea lettuce (*Ulva lactuca*), graceful red weed (*Gracilaria tikvahiae*), dead man's fingers (*Codium fragile*), eelgrass (*Zostera marina*), *Ceramium fastigiatum*, and *Agardhiella subulata* (BBNEP 2001). SAV species exhibit significant spatial and temporal variation that is influenced by a variety of factors, including water temperature, salinity, sediment transport, solar radiation, and turbidity. Most sessile plants, such as eelgrass, occur within one or two meters of the surface, but some, such as sea lettuce, are free-floating and drift according to the prevailing wind and tides. Eelgrass probably represents the most important SAV species because it provides a critical habitat for many species of fish, invertebrates, and plants (McLain and McHale 1996). Eelgrass abundance and density can be indicators of overall water quality and environmental health; however, it is often difficult to compare density estimates between studies because of differences in measurement techniques.

Current research suggests that existing eelgrass beds in Barnegat Bay are susceptible to a variety of stressors, including "wasting disease" caused by the protist *Labyrinthula zosterae*, and the occurrence of dense brown, green, and red algal blooms that block sunlight and interfere with photosynthesis. McLain and McHale (1996) concluded that "eelgrass beds in Barnegat Bay are not a healthy biotype," and recent work by Gastrich et al. (2004) has shown that more than 50 percent of the SAV in Barnegat Bay and Little Egg Harbor exists in areas with a high frequency of algal blooms. Other potential stressors on SAV include damage inflicted by boats, harvesting, climatic fluctuations, changes to soil structure and fertility, lack of adequate water circulation, and changes to tidal range and water exchanges based on dredging or channel modifications. Nonpoint pollution and eutrophication of the bay's water also appear to contribute to some phytoplankton blooms, which result in severe shading of eelgrass.

Salt Marshes

Salt marshes are shallow-water estuarine habitats that provide food and refuge to many fish and invertebrates, habitat for a variety of birds and mammals, and recreational value to human populations. Tidal salt marsh habitat surrounding Barnegat Bay was estimated to occupy 36,694 ac in 1888; mapping conducted in 1995 identified a total of 24,561 ac, representing a 33 percent loss (BBNEP 2001). This was considered to be an overestimate of loss because of differences in measurement techniques and inherent errors associated with salt marsh estimates (BBNEP 2001). The actual loss is estimated at about 28 percent and appears to have occurred during a 30-year period from World War II to the enactment of the New Jersey Wetlands Act of 1970 (Lathrop and Bognar 2001). Most of the loss is attributed to development along the coastal shorelines and dredging conducted by the USACE to maintain access to ports and marinas. Because a series of complex environmental interactions is necessary to maintain salt marshes, anthropogenic impacts associated with changes in hydrology, sediment transport, water salinity, and other factors are very important. Because of the high degree of development that has occurred in Barnegat Bay, the shoreline has been heavily altered, with approximately 36 percent of the nearshore areas bulkheaded and 70 percent of the adjacent upland ecosystem developed (Lathrop and Bognar 2001). Passage of the New Jersey Wetlands Act has helped to slow the loss of salt marshes, but a small and steady loss continues in Barnegat Bay (BBNEP 2001).

Benthic Infauna

Investigations of benthic communities were conducted in Barnegat Bay during the 1960s, 1970s, and 1990s to document spatial and temporal trends resulting from the operation of OCNGS (Kennish 2001a). During the early studies, the dominant species included the bivalve mollusc Mulinaria lateraliz, the polychaete *Pectinaria gouldii*, and the gastropod *Acteocina canaliculata*. Between 1969 and 1973, the densities of these species decreased significantly, with mean densities dropping from 9000 to 17,000 individuals per m^2 in 1969 to less than 500 per m^2 in 1973 (Kennish 2001a; BBNEP 2001). It is not possible to determine specific locations associated with these decreases, nor is it possible to determine whether OCNGS was an important contributor to the declines. However, localized impacts on benthic communities in the vicinity of the plant intake and discharge canals have been documented (Kennish 2001a). These impacts are related to both dredging and excavations required for cooling-water flow, the effects of heated water discharges into Oyster Creek, and the replacement of freshwater and low-salinity environments in Oyster Creek and the Forked River with higher salinity conditions typical of estuaries (BBNEP 2001). At present, a large variety of mobile epifauna inhabit Barnegat Bay, including sand shrimp, grass shrimp, mysid shrimp, mud crabs (*Neopanope* *texana*, *Panopeus herbstii*, and *Rhithropanopeus harrisii*), hard clams, horseshoe crabs (*Limulus polyphemus*), and a variety of gastropods and starfish (Kennish 2001a). The current abundance of these organisms in the estuary has not been estimated with any precision.

Phytoplankton, Zooplankton, and Algal Blooms

Barnegat Bay supports an extensive assemblage of phytoplankton that is responsible for the primary production that is the foundation of marine and estuarine food webs. There is a great deal of variation in the abundance and distribution of phytoplankton and zooplankton, and population cycles vary monthly, seasonally, and annually. A long-term study by the NJDEP (Olsen and Mahoney 2001) evaluated phytoplankton species composition and abundance from 1987 through 1998 and identified a total of 132 species, with 51 of these being new to the Barnegat Bay-Little Egg Harbor estuary. Dinoflagellates and diatoms represented the majority of the species observed, accounting for 100 of the 132 species and 72 percent of the total abundance.

Zooplankton in Barnegat Bay represent the principal herbivorous component of the estuarine ecosystem because they are consumers of phytoplankton and detritus (Kennish 2001b). No recent investigations of zooplankton abundance or species composition have been conducted in Barnegat Bay, but a series of studies was conducted in the bay from about 1975 to 1977 in support of the NJPDES 316(a) and 316(b) demonstrations related to the cooling-water system (Tatham et al. 1977). Dominant species observed during this time were the calanoid copepods *Acartia hudsonica*, *A. tonsa*, and *Oithona colcarva*. *A. hudsonica* dominated during the winter; during the summer, *A. tonsa* and/or *O. colcarva* dominated (Kennish 2001b). All of these species have been identified in entrainment samples from OCNGS. In general, zooplankton abundance is closely tied to phytoplankton abundance, with the highest zooplankton populations occurring in the late spring and summer months following phytoplankton blooms.

Harmful algal blooms occur in bays and estuaries (usually in the summer months) when algal abundances are high enough to affect water clarity and dissolved oxygen content and create unhealthy conditions for fish, invertebrates, and humans. During the 1950s, intense blooms of green algae (*Nannochloris atomus* and *Stichococcus* sp.) were believed to be responsible for the failure of the oyster industry, and prolonged blooms of the dinoflagellate *Prorocentrum micans* from 1968 to 1972 caused sickness and discomfort for bathers (Olsen and Mahoney 2001). During the summer of 1985, *N. atomus* was present in the New York Bight, and residents of Barnegat Bay reported yellowish brown water in lower Barnegat Bay and off Long Beach Island (Olsen 1996). At present, blooms of the pelagophyte *Aureococcus anophagefferens* have created “brown tides” that are suspected of inhibiting the feeding and growth of the hard clam and causing mass mortalities of bay scallops (*Argopecten irradians*) and blue mussels (*Mytilus edulis*), and destruction of eelgrass beds (Olsen and Mahoney 2001).

Based on a 3-year study from 2000 to 2002, Gastrich et al. (2004) estimated that 50 percent of the SAV habitat in Barnegat Bay and Little Egg Harbor was categorized as having a high frequency of Category 2 or 3 blooms, with Category 2 blooms defined as having cell densities of 35,000 to 200,000 cells/mL and Category 3 blooms defined as having cell densities of 200,000 cells/mL or higher. Gastrich et al. (2004) concluded that regional climatic and/or hydrologic changes appear to be major factors in bloom production, and that an increase in salinity associated with extended drought conditions is a critical factor in the initiation of brown tide blooms in Barnegat Bay. Navigational improvements to the Barnegat Inlet in the late 1980s and early 1990s have increased mean tidal ranges in the bay by more than 30 percent, allowing a greater influx of high-salinity water from the Atlantic Ocean to Barnegat Bay. It is also possible that eutrophication of the bay from agricultural and urban runoff is contributing to some of the harmful algal blooms; however, there is no evidence that dissolved organic nitrogen is responsible for brown tide abundance (Gastrich et al. 2004).

2.2.5.5 Threatened or Endangered Aquatic Species

Aquatic species that are listed by the Federal government as threathened or endangered and have the potential to occur in the vicinity of the OCNGS site or along the OCNGS-to-Manitou transmission line corridor are presented in Table 2-4. This list is made up of five sea turtle species, but there is no designated critical habitat in the vicinity of the OCNGS site. There are no reported fish or marine mammals considered threatened or endangered that have been observed in Barnegat Bay, the South Branch of the Forked River, or Oyster Creek.

Table 2-4. Aquatic Species Listed as Endangered or Threatened by the U.S. Fish and Wildlife Service, or National Marine Fisheries Service Known to Occur or That Could Occur in the Vicinity of the OCNGS Site or Along the Transmission Line Corridor

Scientific Name	Common Name	Federal Status[a]	State Status[a]
Caretta caretta	loggerhead sea turtle	T	E
Chelonia mydas	green sea turtle	T	T
Dermochelys coriacea	leatherback sea turtle	E	E
Eretmochelys imbricata	hawksbill sea turtle	E	E
Lepidochelys kempii	Kemp's ridley sea turtle	E	E

(a) Listing status: E = endangered; T = threatened.

Loggerhead Sea Turtle

The loggerhead sea turtle (*Caretta caretta*, family Cheloniidae) was Federally listed as threatened throughout its range in 1978 (NMFS 2005c) and is listed as endangered by the State of New Jersey (NJDEP 2005e). Loggerhead turtles are found in temperate and tropical waters throughout the world and feed in coastal bays and estuaries and in the shallow waters along the continental shelves of the Atlantic, Pacific, and Indian Oceans, where they spend most of their lives. Adult carapace lengths range from 73 to 107 cm, and adults can weigh up to 159 kg.

Their diet consists of shellfish, including horseshoe crabs, clams, and mussels. Adult females return to coastal beaches to lay eggs at intervals of two, three, or four years, and generally lay between 100 to 126 eggs per season (CCC 2005). Loggerheads are the most common sea turtle in the coastal waters of the United States, and the current number of adult females along the U.S. Atlantic and Gulf coasts is believed to be 44,780 (CCC 2005). The greatest threats to survival include the destruction or alteration of nesting and feeding habitats, incidental capture by commercial and recreational fishermen, entanglement in shallow-water debris, and direct physical impact from collisions with commercial or recreational vessel traffic (NMFS 2005c). From 1977 to 2004, 809 loggerhead sea turtle strandings were reported for the New Jersey coast (NRC 2005b).

The operation of the once-through cooling-water system at OCNGS can result in sea turtle mortalities due to impingement and subsequent drowning on intake trash racks. Between 1969 and 2005, seven loggerhead sea turtles (five alive, two dead) were removed from the OCNGS cooling-system trash bars. These impingements occurred in 1992, 1994, 1998, and 2000 (NRC 2005b). The significance of these impingements is discussed in Section 4.6.1.

Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle (*Lepidochelys kempii*, family Cheloniida) was Federally listed as endangered throughout its range in 1970 (NMFS 2005c). The State of New Jersey also considers this turtle endangered (NJDEP 2005e). Kemp's ridley sea turtles are usually found in the Gulf of Mexico; juveniles, however, have been known to range north, entering the waters of New Jersey and Barnegat Bay. The average carapace length of adults is 65 cm; adults can weigh from 35 to 45 kg. Their preferred habitat is shallow areas with sandy or muddy bottoms; their primary diet includes crab, mussels, shrimp, sea urchins, squid, and jellyfish. The Kemp's ridley sea turtle nests annually, arriving at nesting grounds in Mexico in large aggregations. Females lay an average of 110 eggs in each nest, and egg incubation is about 55 days (CCC 2005). The Kemp's ridley sea turtle is considered the most endangered sea turtle, and its population is believed to be in the early stages of recovery. The lowest number of nests (740) was observed in 1985; since that time, however, the number of nests appears to have increased by about 11 percent (NMFS 2000).

The number of nests observed at the primary nesting location (Rancho Nuevo, Tamaulipas, Mexico) in 2000 was 3788, an increase of 2523 nests at that location since 1994 (NRC 2005b). The greatest threats to the survival of Kemp's ridley sea turtles are from human activities, including destruction of nests and collection of eggs and interactions with commercial fisheries (CCC 2005).

Kemp's ridley sea turtles have been observed in Barnegat Bay and have been impinged on OCNGS cooling-system intake trash bars. There were no incidences of impingement until 1992. Since that time, 23 Kemp's ridley sea turtles have been impinged, and approximately 50 percent of the turtles were either dead when found or died shortly thereafter. Sixty-eight Kemp's ridley sea turtle strandings were reported for the New Jersey coast from 1977 to 2004, with 48 of 68 strandings (71 percent) occurring since 1992 (NRC 2005b). The significance of the impingements at OCNGS is discussed in Section 4.6.1.

Leatherback Turtle

The leatherback sea turtle (*Dermochelys coriacea*, family Dermochelyidae) was Federally listed as endangered throughout its range in 1970 (NMFS 2005c). The State of New Jersey also considers this species endangered (NJDEP 2005e). The leatherback sea turtle is found worldwide and has the largest north-south range of all sea turtle species. Adults generally have a carapace length of 121 to 183 cm and weigh between 250 and 700 kg. The largest recorded leatherback was almost 305 cm and weighed 916 kg (CCC 2005). Leatherback sea turtles feed almost exclusively on jellyfish and other soft-bodied organisms (CCC 2005). Females nest every two to three years but often change nesting beaches, making population estimates difficult (CCC 2005; NMFS 2005c). The current population estimate for this species is variable, given the difficulty of determining nesting locations and the number of females. The NMFS (2005c) estimates the number of female leatherbacks to be 20,000 to 30,000; the Caribbean Conservation Corporation (CCC 2005) reports 35,860 nesting females. Pritchard (1983) suggests that the world population estimate may be more than 100,000 females because of the discovery of nesting beaches in Mexico. The primary threats to leatherback sea turtles include capture and suffocation in commercial fishing nets and the ingestion of marine debris (plastic bags, balloons, etc.) that are mistaken for jellyfish (CCC 2005). From 1980 to 2001, 229 leatherback sea turtle strandings were observed along the New Jersey coast. No sightings or impingements of this species have been observed at OCNGS since the station became operational (NRC 2005b).

Hawksbill Sea Turtle

The hawksbill sea turtle (*Eretmochelys imbricata*, family Cheloniidae) was Federally listed as endangered in 1970 (NMFS 2005c). The State of New Jersey also considers this species endangered (NJDEP 2005e). This species is primarily tropical, but has been observed along the Atlantic seaboard as far north as Maine. Most sightings along the eastern U.S. coast have been in Florida and Texas (NRC 2005b; CCC 2005). Hawksbill sea turtles range in length from 76 to 91 cm and weigh between 45 and 70 kg. They feed primarily within coral reef systems. Their narrow heads and jaws allow them to feed on sponges, anemones, squid, and shrimp that exist in crevices and cracks within the reefs. Females nest at intervals of two or more years, and lay an average of 160 eggs in each nest. Nesting may occur between two to four times per season (CCC 2005). The CCC (2005) estimates that there are 22,900 nesting females worldwide, and the NMFS (2005c) believes that the nesting populations are generally declining. The only stable populations were observed in 1983 in Yemen, Oman, the Red Sea, and Australia. The primary threats to this species include harvesting for its shell to create "tortoise shell" ornaments, removal of eggs from nesting sites, destruction or disruption of nesting beaches due to dredging, beachfront armoring, or coastal erosion, and the disorientation of adults and juveniles from artificial lighting of shorelines (NMFS 2005c). No strandings of hawksbill sea turtles have been reported on the coast of New Jersey, and no sightings or impingements of this species have been observed at OCNGS (NRC 2005b).

Green Sea Turtle

The green sea turtle (*Chelonia mydas*, family Cheloniidae) was Federally listed as threatened in U.S. waters and as endangered in Mexican waters in 1970. The State of New Jersey considers this species threatened (NJDEP 2005e). Green sea turtles are found in temperate and tropical waters throughout the world. This species is found in the U.S. Virgin Islands, Puerto Rico, and along the shorelines of the Gulf and Atlantic coasts from Texas to Massachusetts (NMFS 2005c). Adult carapace lengths range from 76 to 91 cm, and adults weigh between 136 and 180 kg. The largest green sea turtle ever found was 152 cm long and weighed 395 kg (CCC 2005). The diet of this species changes as it grows. Young green sea turtles eat polychaetes, small crustaceans, aquatic insects, grasses, and algae. Older green turtles are primarily herbivorous and eat seagrasses and algae (CCC 2005). Green sea turtles nest at intervals of 2 or more years, may nest up to 5 times per season, and produce about 115 eggs per nest, with an incubation period of about 60 days (CCC 2005). The present population estimate for this species is 88,520 nesting females worldwide (CCC 2005); between 200 and 1100 females are believed to nest on U.S. beaches (NMFS 2005c). The primary threats to this species include the commercial harvest of eggs for food and incidental catch in commercial fishing nets. Sixteen green sea turtles have been stranded on New Jersey beaches since 1977; 4 green turtles have been impinged on the OCNGS trash racks since 1969 (3 alive and 1 dead). All

OCNGS impingements occurred between 1999 and 2003 (NRC 2005b). The significance of these impingements at OCNGS is discussed in Section 4.6.1.

2.2.6 Terrestrial Resources

2.2.6.1 Description of Terrestrial Resources in the Vicinity of OCNGS

The 800-ac OCNGS site and the associated 11.1-mi-long OCNGS-to-Manitou transmission line are located within the Barnegat Bay watershed (which encompasses much of Ocean County) and are within the Pinelands National Reserve (Figure 2-2) (AmerGen 2005a). The Pine Barrens is a heavily forested, 1.1 million-ac area of coastal plain located within central and southern New Jersey. “Barrens” refers to the nutrient-poor, sandy soils of the area that limit the growth of agricultural crops.

The OCNGS site consists of man-made structures, dredge spoils, cleared land, upland forest, Atlantic white cedar (*Chamaecyparis thyoides*) swamps, saltwater marshes, and grasslands. The OCNGS site is bisected by U.S. Highway 9 (Figure 2-3). The 150-ac tract west of U.S. Highway 9 contains the plant-related facilities and a 60-ac, mostly undeveloped, buffer strip that includes a small area of emergent scrub-shrub and forested wetlands. The 650-ac tract east of U.S. Highway 9 is the former Finninger Farm. It is primarily composed of forests (25 percent), abandoned farmland (65 percent), and surface waters (10 percent). The eastern third of Finninger Farm has been colonized by the invasive non-native common reed (*Phragmites australis*), with beaches and tidal wetlands occurring along the eastern edge of the property (AmerGen 2005a). A dredge spoils basin on the Finninger Farm area has been used for disposal of material dredged from the OCNGS intake and discharge canals. The dredge spoils basin occupies about 17.5 ac (2.7 percent) of the Finninger Farm area (Figure 2-3). Monitoring equipment used as part of the ongoing radiological monitoring program is also located on the Finninger Farm portion of the OCNGS site. Otherwise, the area functions as an undeveloped buffer area that is not planned for development during the license renewal period (AmerGen 2005a).

The 240-ft wide, 230-kV OCNGS-to-Manitou transmission line parallels the Garden State Parkway for much of its length. Much of the transmission line right-of-way traverses pitch pine (*Pinus rigida*) forests and Atlantic white-cedar swamp forests (AEC 1974). However, it also crosses several streams (e.g., three branches of the Forked River, Huckleberry Branch, Deep Hollow Branch, Cedar Creek, Factory Branch, and Jakes Branch) and associated wetlands, bogs, ponds, and agricultural lands (AmerGen 2005a). The OCNGS-to-Manitou transmission line parallels the eastern boundary of the Forked River Wildlife Management Area for about 1 mi, and about 1.5 mi of the transmission line occurs within the northeastern corner of the Forked River Wildlife Management Area. About 1 mi of the transmission line also crosses through the Double Trouble State Park (AmerGen 2005a).

A second transmission line connects OCNGS to the grid. As discussed in Section 2.1.7 of this SEIS, the OCNGS-to-Cedar transmission line is outside the scope of the OCNGS license renewal because it was constructed and placed in operation recently. A separate environmental impact statement was prepared that evaluated the impacts associated with construction and operation of this transmission line (ENSR International 2004).

Natural habitats and associated biota within the Barnegat Bay watershed have been adversely impacted by a wide variety of factors, including nonpoint source pollution; water-quality degradation; and habitat loss, fragmentation, and alteration. Habitat fragmentation and associated human development have resulted in an increase in predators (e.g., blue jay [*Cyanocitta cristata*], American crow [*Corvus brachyrhynchos*], raccoon [*Procyon lotor*], red fox [*Vulpes vulpes*], and feral cats [*Felis silvestris*]); the brown-headed cowbird (*Molothrus ater*), a brood parasite; herbivores (e.g., white-tailed deer [*Odocoileus virginianus*]); and invasive plant species (BBNEP 2001; New Jersey Audubon Society 2005). A loss of about 20 percent of the upland forests and 6 percent of the wetland forests occurred within the Barnegat Bay watershed between 1972 and 1995 (Lathrop et al. 1999). Also, about 71 percent of Barnegat Bay's shoreline buffer zone has been developed or altered, leaving only 29 percent in its natural land cover; about 28 percent of Barnegat Bay's salt marshes have been lost to development (Lathrop et al. 1999).

More than 60 percent of New Jersey's vascular plant species are not native to the region. These species can crowd out native species and alter the structure and function of natural communities (Snyder and Kaufman 2004). Wetlands are especially susceptible to invasive species, with purple loosestrife (*Lythrum salicaria*) and common reed being two of the major threats. The invasive non-native upland plant species of most concern are the autumn olive (*Eleagnus umbellata*), multiflora rose (*Rosa multiflora*), and Japanese barberry (*Berberis thunbergii*) (Snyder and Kaufman 2004).

In general, about 15 percent of the Pine Barrens has been modified for agricultural and urban uses, 20 percent is wetlands, and the remaining 65 percent is upland forests (McCormick 1978). Upland forest types of the Pine Barrens include pine, mixed pine-hardwood, and hardwood forests. Pine forests are dominated by pitch pine, oaks (*Quercus* spp.), northern bayberry (*Myrica pensylvanica*), red maple (*Acer rubrum*), and sassafras (*Sassafras albidum*). Mixed pine-hardwood forests are characterized by pitch pine, oaks, black tupelo (*Nyssa sylvatica*), and sassafras; oaks are more numerous than in the pine forests. The hardwood forests are characterized by black, white, scarlet, and blackjack oaks (*Q. velutina*, *Q. alba*, *Q. coccinea*, and *Q. marilandica*) (AEC 1974). The understory of the upland forests is dominated by either scrub oak (*Q. ilicifolia*) or various heath plants such as mountain laurel (*Kalmia latifolia*), huckleberries (*Gaylussacia* spp.), and blueberries (*Vaccinium* spp.) (FWS 1997; BBNEP 2001). Herbaceous plants are sparse within upland forests of the Pine Barrens. Common species include bracken fern (*Pteridium aquilinum*) and common wintergreen (*Chimaphila umbellata*) (McCormick 1978).

The intensity and frequency of fires are among the most important factors controlling the composition of upland forests. If fires are controlled in the Pine Barrens and no other disturbances such as cutting occur, the pine forests are eventually replaced by hardwood forests (Little 1978; McCormick 1978).

Three distinct vegetation areas occur within the coastal marshes of Ocean County: (1) the area covered by water during every high tide that is dominated by smooth cordgrass (*Spartina alterniflora*); (2) the area sometimes covered by normal high tides that is dominated by the short form of smooth cordgrass, sedges, and marsh grass; and (3) the area that is only inundated by the spring and fall tides and winter storm tides and that has a greater diversity of vegetation (BBNEP 2001). The wetland plant communities that occur within the Pine Barrens include (1) Atlantic white cedar forests; (2) broadleaf or hardwood swamp forests dominated by red maple and black tupelo; (3) pitch pine lowland and pine transition forests; (4) shrubby wetlands; and (5) herbaceous wetlands, including both submerged and aquatic vegetation (BBNEP 2001). About 20 shrub species are found in the understory of wetland forests and are dominated by blueberries, swamp azalea (*Rhododendron viscosum*), sweet pepperbush (*Clethra alnifolia*), and greenbriers (*Smilax* spp.) (BBNEP 2001). Wetlands occupy about 22 percent of the Oyster Creek watershed (Zampella et al. 2004).

About 30 amphibian species occur within the Pine Barrens, but only about 10 species are common because of the naturally acidic conditions (pH of 3.6 to 5.2) of many of the Pine Barrens aquatic habitats. The Pine Barrens treefrog (*Hyla andersonii*) and carpenter frog (*Rana virgatipes*) are among the few amphibian species that can tolerate these acidic conditions (Hastings 1978). Frog and toad species that have widespread and stable populations within the Pine Barrens include the spring peeper (*Pseudacris crucifer*), gray treefrog (*H. versicolor*), bullfrog (*R. catesbeiana*), green frog (*R. clamitans*), wood frog (*R. sylvatica*), southern leopard frog (*R. sphenocephala*), pickerel frog (*R. palustris*), and Fowler's toad (*Bufo fowleri*) (BBNEP 2001). These species mostly breed in altered habitats (e.g., abandoned gravel pits) where acidity is less extreme. Salamanders that are common to the Pine Barrens include the red salamander (*Pseudotriton ruber*) and redback salamander (*Plethodon cinereus*) (Hastings 1978).

About 30 reptile species occur within the Pine Barrens. Common turtle species include the eastern box turtle (*Terrapene carolina*), northern painted turtle (*Chrysemys picta*), spotted turtle (*Clemmys guttata*), and snapping turtle (*Chelydra serpentina*) (Hastings 1978). The fence lizard (*Sceloporus undulatus*) is the most common lizard species. Several snakes (e.g., eastern kingsnake [*Lampropeltis getula*] and northern water snake [*Nerodia sipedon*]) occur within the wetlands of the Pine Barrens. Most other reptile species occur within upland forested habitats, including the scarlet snake (*Cemophora coccinea*), black racer (*Coluber constrictor*), corn snake (*Elaphe guttata*), eastern hognose snake (*Heterodon platirhinos*), milk snake (*L. triangulum*), and rough green snake (*Opheodrys aestivus*) (Hastings 1978; BBNEP 2001).

Amphibian and reptile species have declined in Ocean County over the past several decades because of habitat degradation and loss, road mortality, pollution, illegal collecting and killing, and predation from domestic and feral animals (BBNEP 2001).

At least 290 bird species have been observed within the Edwin B. Forsythe National Wildlife Refuge (FWS 1993a), a multiparceled refuge that is located along the coastal and near-coastal portions of Ocean and Atlantic Counties. The refuge parcels closest to OCNGS occur immediately north of the Forked River and south of Oyster Creek (FWS 2004a). Only about 50 bird species are common within the Pine Barrens. Among these species are the eastern towhee (*Pipilo erythrophthalmus*), blue jay (*Cyanocitta cristata*), Carolina chickadee (*Poecile carolinensis*), pine warbler (*Dendroica pinus*), prairie warbler (*D. discolor*), black-and-white warbler (*Mniotilta varia*), ovenbird (*Seiurus aurocapillus*), and brown thrasher (*Toxostoma rufum*). The gray catbird (*Dumetella carolinensis*), yellow warbler (*Dendroica petechia*), common yellowthroat (*Geothlypis trichas*), American redstart (*Setophaga ruticilla*), and field sparrow (*Spizella pusilla*) are common in dense riparian vegetation. The red-winged blackbird (*Agelaius phoeniceus*), swamp sparrow (*Melospiza georgiana*), and song sparrow (*M. melodia*) are common among emergent vegetation. Various heron, egret, and duck species occur in the Pine Barren rivers and lakes (Hastings 1978). Some 20 species of colonial-nesting birds nest within the Barnegat Bay estuarine habitats, including beach nesting birds (e.g., black skimmer [*Rynchops niger*] and least tern [*Sterna antillarum*]), tree and shrub nesting birds (e.g., herons, egrets, and ibises), and some gull and tern species that nest on salt marsh islands and dredged spoil islands (BBNEP 2001). The abundance of some bird species within estuarine habitats has been decreasing over the past several decades because of loss of habitat, disturbance, and predation (BBNEP 2001).

Barnegat Bay is located within the Atlantic flyway and is an important migration and wintering habitat for more than 20 waterfowl species. The more common species include American black duck (*Anas rubripes*), mallard (*A. platyrhynchos*), American widgeon (*A. americana*), green-winged teal (*A. crecca*), brandt (*Branta bernicla*), Canada goose (*B. canadensis*), bufflehead (*Bucephala albeola*), common goldeneye (*B. clangula*), canvasback (*Aythya valisineria*), greater scaup (*Aythya marila*), lesser scaup (*A. affinis*), red-breasted merganser (*Mergus serrator*), common merganser (*M. merganser*), hooded merganser (*Lophodytes cucullatus*), mute swan (*Cygnus olor*), and long-tailed duck (*Clangula hyemalis*) (BBNEP 2001). In winter, waterfowl sometimes congregate around the open water of the OCNGS thermal plume. Waterfowl provide considerable economic and recreational value to the area (e.g., hunting and bird-watching) (BBNEP 2001).

Many shorebird species pass through the Barnegat Bay region during spring and fall migrations. The most abundant species are the sanderling (*Calidris alba*), semipalmated sandpiper (*C. pusilla*), red knot (*C. canutus*), dunlin (*C. alpina*), semipalmated plover

(*Charadrius semipalmatus*), short-billed dowitcher (*Limnodromus griseus*), and ruddy turnstone (*Arenaria interpres*). The willet (*Catoptrophorus semipalmatus*), American oystercatcher (*Haematopus palliatus*), and piping plover (*Charadrius melodus*) are the only shorebird species that nest within Barnegat Bay. The habitat for these three species has been diminished or altered because of beach stabilization, residential and commercial development, disturbance, and predation (BBNEP 2001). The Barnegat Bay estuary is also an important staging and overwintering area for seabirds such as cormorants (*Phalacrocorax* spp.), scooters (*Melanitta* spp.), loons (*Gavia* spp.), northern gannet (*Morus bassanus*), sooty shearwater (*Puffinus griseus*), and Wilson's storm petrel (*Oceanites oceanicus*) (BBNEP 2001).

The most common raptor species within the Barnegat Bay estuary are osprey (*Pandion haliaetus*), peregrine falcon (*Falco peregrinus*), and northern harrier (*Circus cyaneus*). The greatest threat to these species is human disturbance; however, limited nesting site availability, predation, and contaminants also impact the species to varying extents (BBNEP 2001). The red-tailed hawk (*Buteo jamaicensis*) and American kestrel (*Falco sparverius*) are among the more common raptor species.

Most neotropical migrant birds within the Barnegat Bay watershed are forest, scrub-shrub, and grassland species. Habitat loss and fragmentation are the primary impacts on this group of birds (BBNEP 2001).

About 34 mammal species occur within the Pine Barrens; approximately 20 are common (Hastings 1978). Mammals common within forested habitats include white-tailed deer, red fox, gray fox (*Urocyon cinereoargenteus*), raccoon, long-tailed weasel (*Mustela frenata*), striped skunk (*Mephitis mephitis*), Virginia opossum (*Didelphis virginiana*), eastern gray squirrel (*Sciurus carolinensis*), red squirrel (*Tamiasciurus hudsonicus*), eastern chipmunk (*Tamias striatus*), southern flying squirrel (*Glaucomys volans*), white-footed mouse (*Peromyscus leucopus*), and woodland vole (*Microtus pinetorum*). The red fox and raccoon are widespread both on the mainland and barrier islands. Shrubland and grassland species include meadow vole (*M. pennsylvanicus*), meadow jumping mouse (*Zapus hudsonius*), woodchuck (*Marmota monax*), and eastern cottontail (*Sylvilagus floridanus*). Those occurring within wetlands and along streams and rivers include mink (*Mustela vison*), river otter (*Lontra canadensis*), beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), southern bog lemming (*Synaptomys cooperi*), and least shrew (*Cryptotis parva*) (BBNEP 2001).

Hunting and trapping of mammals occur within the Barnegat Bay watershed. The white-tailed deer, eastern cottontail, and gray squirrel are the most commonly hunted species, while some hunting also occurs for raccoon and foxes. Trapping occurs for raccoon, striped skunk, foxes, long-tailed weasel, mink, and beaver (BBNEP 2001).

2.2.6.2 Threatened or Endangered Terrestrial Species

Federally and State-listed, proposed, or candidate terrestrial species found in Ocean County are presented in Table 2-5. For some bird species, there is a dual State status, one for the breeding population and the other for the migratory or winter population (NJDEP 2001b). On October 12, 2005, the NRC contacted the U.S. Fish and Wildlife Service (FWS) and requested information on Federally listed and proposed threatened and endangered species, candidate species, and critical habitat on and near the OCNGS site (NRC 2005a). In its response, the FWS stated that except for an occasional transient bald eagle (*Haliaeetus leucocephalus*), no Federally listed or proposed threatened or endangered species under FWS jurisdiction are known to occur within the OCNGS area (FWS 2005b). However, the Federally listed swamp pink (*Helonias bullata*), Knieskern's beaked-rush (*Rhynchospora knieskernii*), and the Federal candidate bog asphodel (*Narthecium americanum*) have been reported within 2.8, 1.5, and 1.3 mi, respectively, of the project area (FWS 2005b). The 10 Federally listed species and the single candidate species for Federal listing that are reported from Ocean County are discussed below. No designated critical habitats for Federally listed species occur on either the OCNGS site or the associated OCNGS-to-Manitou transmission line corridor.

Seabeach Amaranth

The federally listed threatened seabeach amaranth (*Amaranthus pumilus*, family Amaranthaceae) historically occurred on barrier island beaches from Massachusetts to South Carolina. Significant numbers are now only known from New York and the Carolinas, with small populations in Delaware, Maryland, and New Jersey (NJONLM 2003; NatureServe 2005). The seabeach amaranth requires extensive areas of barrier island beaches and inlets that allow it to colonize suitable habitat as it becomes available (FWS 1996). The seabeach amaranth inhabits the coastal overwash flats at the accreting ends of barrier islands and the lower foredunes. On ocean beaches, the seabeach amaranth occurs above mean high tide, and during the growing season it is intolerant of even occasional flooding (FWS 1996; NatureServe 2005). Seeds can remain viable in buried sand for years and germinate after being brought near the surface following severe storms (NatureServe 2005). Threats to the seabeach amaranth include beach erosion and tidal inundation, herbivory by webworms (the caterpillar of various species of small moths), habitat fragmentation, beach stabilization structures, dune fencing, development, recreational use, and all-terrain vehicles (ATVs) (FWS 1996; CPC 2005; NatureServe 2005). Habitat for the seabeach amaranth does not occur on the OCNGS site or the OCNGS-to-Manitou transmission line right-of-way.

Table 2-5. Federally Listed and State-Listed Terrestrial Species Potentially Occurring on or in the Vicinity of OCNGS and Associated Transmission Line

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	Habitat
Plants				
Amaranthus pumilus	seabeach amaranth	T	E	Barrier island beaches
Arnoglossum atriplicifolium	pale Indian plantain	–	E	Wooded slopes, rocky stream margins, open woods
Cardamine longii	Long's bittercress	–	E	Moist alluvial soils in woods
Cirsium virginianum	Virginia thistle	–	E	Bogs and wet pine barrens
Clitoria mariana	butterfly-pea	–	E	Upland rocky woods, sandstone glades, ravines, ridges
Corema conradii	broom crowberry	–	E	Sandy pine barrens, sandhills
Desmodium pauciflorum	few-flower tick-trefoil	–	E	Moist woods, ravines, bluff bases
Eleocharis tortilis	twisted spike-rush	–	E	Swamps, wet woods, and thickets
Eriophorum tenellum	rough cotton-grass	–	E	Bogs and wet, peaty substrates
Eupatorium resinosum	Pine Barren boneset	–	E	Open bogs, swamps, streamsides
Eurybia radula	low rough aster	–	E	Wet woods, swamps
Fraxinus profunda	pumpkin ash	–	E	Swamps, bottomlands
Galactia volubilis	downy milk-pea	–	E	Dry thickets, borders of woods
Glaux maritima	sea-milkwort	–	E	Seashores, salt marsh borders
Gnaphalium helleri	small everlasting	–	E	Dry clearings, wood and field borders
Helonias bullata	swamp pink	T	E	Swamps, bogs
Hottonia inflata	featherfoil	–	E	Wet sloughs, ditches
Jeffersonia diphylla	twinleaf	–	E	Rich, damp, open woods
Juncus caesariensis	New Jersey rush	–	E	Pineland bogs, cedar swamps
Juncus torreyi	Torrey's rush	–	E	Wet meadows, prairies, swamps, marshes
Limosella subulata	awl-leaf mudwort	–	E	Tidal mudflats, muddy or sandy shores
Linum intercursum	sandplain flax	–	E	Dry, open sandplain grasslands, sand barrens, rights-of-way, mowed fields
Luzula acuminata	hairy wood-rush	–	E	Woods, clearings, bluffs

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	Habitat
Melanthium virginicum	Virginia bunchflower	–	E	Meadows, moist woods, seepages, damp clearings, wet thickets
Myriophyllum tenellum	slender water-milfoil	–	E	Water up to 5 ft deep; in sand, granitic gravel, mud, peat
Myriophyllum verticillatum	whorled water-milfoil	–	E	Shallow waters
Narthecium americanum	bog asphodel	C	E	Moist savannahs, sandy bogs
Oenothera humifusa	sea-beach evening-primrose	–	E	Beach dunes and other dry, sandy coastal sites
Onosmodium virginianum	Virginia false-gromwell	–	E	Pinelands, dry sandy woods, open sands
Plantago pusilla	dwarf plantain	–	E	Fields, roadsides, open woods
Polygonum glaucum	sea-beach knotweed	–	E	Sandy beaches above the tide limit
Prunus angustifolia	chickasaw plum	–	E	Dry thickets, woodland edges
Ranunculus cymbalaria	seaside buttercup	–	E	Brackish to saline shores
Rhododendron atlanticum	dwarf azalea	–	E	Moist, flat pine woods and coastal savannahs
Rhynchospora globularis	coarse grass-like beaked-rush	–	E	Upland prairies, sandy and rocky stream banks, sink-hole ponds
Rhynchospora knieskernii	Knieskern's beaked-rush	T	E	Early-successional wet areas in gravel and clay pits, rights-of-way, recent burns, muddy swales, cleared areas
Rhynchospora microcephala	small-head beaked-rush	–	E	Early successional wetlands, disturbed wet areas
Schoenoplectus maritimus	saltmarsh bulrush	–	E	Estuarine intertidal emergent wetlands

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	Habitat
Schwalbea americana	chaffseed	E	E	Open pine flat woods, longleaf pine/oak sandhills, pitch pine lowland forests, seepage bogs, palustrine pine savannahs, ecotonal areas between peaty wetlands and xeric sandy soils
Scirpus longii	Long's woolgrass	–	E	Swamps, marshes, wet meadows
Spiranthes laciniata	lace-lip ladies'-tresses	–	E	Bogs, marshes, shallow ponds
Stylisma pickeringii var. *pickeringii*	Pickering's morning-glory	–	E	Sand hills and sandy woods with little or no vegetation; can occur in roadsides and disturbed areas
Tridens flavus var. *chapmanii*	Chapman's redtop	–	E	Roadsides, open woodlands, dry fields
Triglochin maritima	seaside arrow-grass	–	E	Saline to freshwater marshes and shores
Utricularia biflora	two-flower bladderwort	–	E	Shallow pools
Utricularia minor	lesser bladderwort	–	E	Shallow pools, wet meadows, bogs, shores
Uvularia puberula var. *nitida*	Pine Barren bellwort	–	E	Moist to dry, open woods
Verbena simplex	narrow-leaf vervain	–	E	Meadows, fields, prairies
Xyris fimbriata	fringed yellow-eyed-grass	–	E	Wet prairies, savannahs and pine flat woods, pond and lake margins, wet depressions, ditches
Zigadenus leimanthoides	death-camus	–	E	Sandy pinelands and bogs
Insects				
Cicindela dorsalis dorsalis	northeastern beach tiger beetle	T	E	Long, wide, and relatively undisturbed sandy beaches
Nicrophorus americanus	American burying beetle	E	E	Coastal grassland, scrub areas

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[a]	State Status[a]	Habitat
Amphibians				
Ambystoma tigrinum tigrinum	eastern tiger salamander	–	E	Old fields and woods under logs or in underground tunnels and burrows; breeds in shallow woodland ponds, old gravel pits, and farm ponds that lack fish predators
Hyla andersonii	Pine Barrens treefrog	–	E	Atlantic white cedar swamps and pitch pine lowlands with dense mats of sphagnum moss; preferred habitats have an open canopy, dense shrub layer, and heavy ground cover with sands and muck; breeding ponds are less than 24 in. deep with clean, acidic waters
Hyla chrysoscelis	southern gray treefrog	–	E	Small freshwater ponds, old fields and mixed forest uplands; breeds in vernal ponds and other aquatic habitats where predatory fish are absent
Reptiles				
Glyptemys insculpta	wood turtle	–	T	Freshwater streams and rivers used for mating, feeding, and hibernation; terrestrial habitats (e.g., open fields, thickets, mid-successional forests, agricultural fields and pastures) used for egg laying and foraging
Glyptemys muhlenbergii	bog turtle	T	E	Calcareous fens, sphagnum bogs and wet, grassy pastures; habitats are well-drained with water depths rarely exceeding 4 in.
Crotalus horridus horridus	timber rattlesnake	–	E	Swamps and pine-oak forests; usually dens in cedar swamps and along stream banks

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	Habitat
Elaphe guttata guttata	corn snake	–	E	Sandy upland pine forests with uprooted trees, stump holes and rotten logs with an understory of low brush and a stream or pond in the area; forages along open fields and forest edges
Pituophis melanoleucus melanoleucus	northern pine snake	–	T	Dry pine-oak forests on infertile sandy soils within which they dig hibernacula and summer dens; openings important for nesting and basking
Birds				
Accipiter cooperii	Cooper's hawk	–	T (B, MW)	Riparian and wetland forests; breeding habitats include large, remote red maple, black gum, and, occasionally, Atlantic white cedar swamps; forest edges and small openings along streams and roads used for hunting
Ammodramus savannarum	grasshopper sparrow	–	T (B)	Breeds in grasslands, upland meadows, pastures, hayfields and old fields that contain short- to medium-height bunch grasses with patches of bare ground, a shallow litter layer, scattered forbs, and a few shrubs; non-breeding habitat similar, but less restrictive
Bartramia longicauda	upland sandpiper	–	E	Grasslands, fallow fields and meadows that are often associated with pastures, farms or airports; nests in upland meadows and short grass grasslands where vegetation height does not exceed 28 in.

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	Habitat
Botaurus lentiginosus	American bittern	–	E (B)	Freshwater emergent wetlands, coastal salt or brackish marshes, and grassy fields during migration or winter; nests in freshwater emergent wetlands
Calidris canutus	red knot	–	T	Open landscapes and coastal areas; nests on bare soil, grass, and pebbles
Charadrius melodus	piping plover	T	E	Oceanfront beaches and barrier islands; forage on intertidal beaches, washover areas, exposed mudflats and sandflats, wracklines and shorelines; typically nests on stretches of beach between dunes and high-tide line with nests often located in flat areas with shell fragments and sparse vegetation
Circus cyaneus	northern harrier	–	E (B)	Open landscapes such as tidal marshes, emergent wetlands, fallow fields, grasslands, meadows, airport and agricultural areas; forage over marshes, fields, bushes, and edge habitats that contain low vegetation
Cistothorus platensis	sedge wren	–	E	Wet meadows, freshwater marshes lacking cattails, bogs, and drier portions of salt or brackish coastal marshes
Falco peregrinus	peregrine falcon	–	E	Open landscapes and rocky places or cliffs; nests on cliffs, deciduous trees, buildings, nesting platforms and bridges (no cliff nests remain in New Jersey); forages over open areas such as marshes, beaches, and open water

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[a]	State Status[a]	Habitat
Haliaeetus leucocephalus	bald eagle	T	E	Forested areas associated with large bodies of water; nesting sites not reported from project area; tidal areas of southern New Jersey provide winter foraging
Laterallus jamaicensis	black rail	–	T (B, MW)	Coastal salt and brackish marshes, nests in areas of elevated marshes that only flood during extremely high tides
Melanerpes erythrocephalus	red-headed woodpecker	–	T (B, MW)	Open forests, forest edges, and grasslands with scattered trees; nests on snags, deciduous and coniferous trees, and man-made structures
Nyctanassa violacea	yellow-crowned night-heron	–	T (B, MW)	Hunts along shores of tidal creeks and tide pools within salt and brackish marshes, shallow water and mudflats; nests on barrier islands, dredge spoil islands and bay islands that contain forested wetlands; residential neighborhoods, parks, campgrounds, or other areas in close association with humans also used for nesting
Nycticorax nycticorax	black-crowned night-heron	–	T (B)	Forests, scrub-shrub, marshes, and ponds used for nesting, roosting, and foraging; heronries located in swamps, coastal dune forests, vegetated dredge spoil islands, scrub thickets, or mixed *Phragmites* marshes that are close to water

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[a]	State Status[a]	Habitat
Pandion haliaetus	osprey	–	T (B, MW)	Lakes, rivers, and seashore areas; nests on deciduous and coniferous trees, snags, man-made structures (e.g., transmission line support structures), and, infrequently, open ground within coastal marshes
Podilymbus podiceps	pied-billed grebe	–	E (B)	Nests in freshwater marshes associated with ponds, bogs, lakes, reservoirs, and slow-moving rivers with breeding sites typically having fairly deep water (up to 6.6 ft) interspersed with submerged or floating aquatic vegetation and dense emergent vegetation; nonbreeding season habitats more diverse
Pooecetes gramineus	vesper sparrow	–	E	Cultivated fields, grasslands, fallow fields, and pastures; habitats typically are dry and well-drained and sparsely vegetated with patches of bare ground, low vegetation and scattered shrubs, or saplings; nests placed within clumps of herbaceous cover
Rynchops niger	black skimmer	–	E	Nests on open sandy beaches, inlets, sandbars, offshore islands and dredge disposal islands that are sparsely vegetated and contain shell fragments; forages in shallow tidal creeks, inlets, and ponds

Table 2-5. (contd)

Scientific Name	Common Name	Federal Status[(a)]	State Status[(a)]	Habitat
Sterna antillarum	least tern	–	E	Barrier island beaches, mainland beach strands, unvegetated sandy dredge spoil sites and sand piles near sand and gravel mining pits; forages in bays, lagoons, estuaries, and rivers and lakes along the coast
Sterna dougallii dougallii	roseate tern	E	E	Nests on barrier islands and salt marshes often within densely vegetated dunes; forages over shallow coastal waters, inlets, and offshore areas
Strix varia	barred owl	–	T (B, MW)	Remote, contiguous, old-growth wetland forests with open understory; nests on snags and deciduous and coniferous trees
Mammals				
Lynx rufus	bobcat	–	E	Swamps, river bottoms, and forests; generally uses rough, broken habitats that have a mixture of successional stages and dense cover

(a) Listing status: B = State breeding population for bird species; C = candidate; E = endangered; MW = migratory or winter population for bird species; T = threatened; – = not listed.
Sources: NJDEP 2001b, 2005e, 2005f,g; SJRCDC 2002; Nearctica.com 2003; ENSR International 2004; MDOC 2004; Biological Research Associates 2005; CPC 2005; NatureServe 2005; Robert W. Freckmann Herbarium 2005; Kantrud 1996; USDA (undated)

Swamp Pink

The Federally listed threatened swamp pink (*Helonius bullata*, family Liliaceae) has been reported from two locations within 2.8 mi of the OCNGS site (FWS 2005a). The swamp pink is an obligate wetland species that occurs in forested freshwater wetlands and requires habitat that is saturated but not flooded (FWS 1991a; CPC 2005). It is generally associated with evergreen trees such as Atlantic white cedar, pitch pine, American larch, and black spruce (CPC 2005). The swamp pink usually occurs in mucky substrates along small streams, headwater wetlands, and spring seepage areas (FWS 2005a). It is shade tolerant; it requires enough canopy to reduce competition from more aggressive species and cannot survive in open sun (FWS 1991a). In areas with little canopy, white-tailed deer are more likely to consume the plant (CPC 2005). It is usually found as clumps of plants rather than as individuals, because new plants grow from rootstocks and there is limited dispersal of seeds. Large populations may be in the thousands, with densities of more than five plants per square foot (FWS 1991a). It flowers from early April to mid-May and has basal leaves that remain green throughout the year (NatureServe 2005). The species is impacted by changes in hydrology, habitat loss and degradation, illegal collecting, trampling, and reduced genetic variation (FWS 1991a, 2005a; CPC 2005). Based on its habitat requirements, it is unlikely to occur on the OCNGS site or along the OCNGS-to-Manitou transmission line right-of-way.

Bog Asphodel

The Federal candidate species bog asphodel (*Narthecium americanum*, family Liliaceae) is reported from within the OCNGS site and from several other locations within 1.3 mi of the site (FWS 2005a). Existing populations are known only from the New Jersey Pine Barrens (NatureServe 2005). It inhabits moist savannahs; broad, wet, sandy bogs along streams in the Pine Barrens; lowland oxbow meanders; iron ore streamlet seeps; and borders of Atlantic white cedar swamps (FWS 2005a; NJDEP 2005f). The bog asphodel is dependent on water moving through the substrate (NJDEP 2005f). It reproduces by both seeds and vegetative propagation through rhizomes (CPC 2005). It cannot tolerate extended periods of flooding or drought, or heavy shade. The species is threatened by habitat loss, hydrologic changes (e.g., due to flooding by cranberry growers, beaver activity, and impoundments), natural vegetation succession (e.g., shading), herbivory by white-tailed deer, and crushing by ATVs (CPC 2005; FWS 2005a; NJDEP 2005f). Based on the bog asphodel's habitat requirements, it is unlikely to occur on the OCNGS site or along the OCNGS-to-Manitou transmission line right-of-way.

Knieskern's Beaked-Rush

The Federally listed threatened Knieskern's beaked-rush (*Rhynchospora knieskernii*, family Cyperaceae) has been reported within 1.5 mi from the OCNGS site (FWS 2005a). It occurs in early successional wetlands with a fluctuating water table in the Pine Barrens of New Jersey, as well as in disturbed sites such as borrow and clay pits, ditches, rights-of-way, and unimproved roads (FWS 2005a). Being intolerant of shade, it occurs on mostly bare substrates with limited vegetation (FWS 2005a). It generally occurs on highly acidic, nutrient poor, fine-grained mineral soils over clay deposits; the largest populations occur on natural bog iron deposits (CPC 2005; NatureServe 2005). It is generally found on bare or sparsely vegetated areas that are maintained by fire, flooding, or human disturbances such as along rights-of-way or in inactive sand and clay pits (FWS 1993b; NatureServe 2005). Existing populations are only known from the Pine Barrens (FWS 1993b; NatureServe 2005). The Knieskern's beaked-rush is threatened by habitat loss (e.g., from agriculture, development, and habitat modification), loss of fire-maintained habitats, ATVs, trash dumping, recreation (e.g., trampling), drought, illegal collecting, and natural succession, which increases shading and competition from other plants (FWS 1993b, 2005a; CPC 2005; NatureServe 2005). Based on the Knieskern beaked-rush's habitat requirements, it is unlikely to occur on the OCNGS site or along the OCNGS-to-Manitou transmission line right-of-way.

Chaffseed

The Federally listed endangered chaffseed (*Schwalbea americana*, family Scrophulariaceae) is a coastal plains species that inhabits acidic, sandy, or peaty soils in open pine flatwoods, pitch pine lowland forests, seepage bogs, palustrine pine savannahs, and other grass- and sedge-dominated habitats (FWS 1995; NatureServe 2005). The chaffseed is considered a facultative wetland species; it can sometimes inhabit drier upland areas and is rarely found in inundated wetlands (CPC 2005). The chaffseed occurs in species-rich plant communities that are dominated by grasses and sedges. It is parasitic on the roots of a number of woody plants (CPC 2005) and blooms from about June to late July (NatureServe 2005). The chaffseed can persist in an area as long as the habitat remains relatively open by periodic activities such as fire, mowing, and fluctuating water tables (FWS 1995; CPC 2005). Threats to the chaffseed include habitat conversion to farmland, residential development, road building, overcollection, mowing during the flowering period, trampling, and fire suppression that promotes woody vegetation (FWS 1995; CPC 2005; NatureServe 2005). Within Ocean County, the chaffseed has only been reported from the northeastern portion at Point Pleasant Beach. All recorded occurrences of the chaffseed in New Jersey are historical rather than recent (SJRCDC 2002). It is highly unlikely that the chaffseed occurs on the OCNGS site or along the OCNGS-to-Manitou transmission line right-of-way.

Northeastern Beach Tiger Beetle

The Federally listed threatened northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*, family Cicidelidae) is one of four subspecies of *C. dorsalis*. The 0.5- to 0.6-in. long beetle inhabits long, wide, relatively undisturbed sandy beaches along the Atlantic Ocean from Cape Cod to central New Jersey and along both shores of Chesapeake Bay (FWS 1994; NJDEP 2005e). It occurs from the foredune to the high-tide line. The adults are most active in July. The larvae live in burrows in the sand (NatureServe 2005). The life cycle takes 2 to 3 years, and the larvae seal off their burrows when they initiate hibernation in early fall (NatureServe 2005). Adults scavenge on dead fish and hunt invertebrates while the larvae sit and wait for passing prey (NatureServe 2005). Threats to the northeastern beach tiger beetle include ATVs, coastal development, beach stabilization, and severe storms that remove surface sands (FWS 1994; NatureServe 2005). All recorded occurrences of the northeastern beach tiger beetle in Ocean County are historical rather than recent (SJRCDC 2002). It is presumed to be extirpated from New Jersey (FWS 1994). Habitat for the species does not occur on the OCNGS site or the OCNGS-to-Manitou transmission line right-of-way.

American Burying Beetle

The Federally listed endangered American burying beetle (*Nicrophorus americanus*, family Silphidae) is the largest native member of the carrion beetle family in North America and averages 1.2 in. long. It originally occurred throughout temperate eastern North America, but natural populations now occur only on Block Island off of the coast of Rhode Island and in eastern Oklahoma (FWS 1991b). Adults primarily live aboveground but overwinter within soil. They are active from April through September and require an air temperature of 60 °F for activity. Eggs are laid adjacent to buried carrion (NatureServe 2005). Carrion availability is probably more important to the American burying beetle's occurrence than the type of vegetation or soils (FWS 1991b). Habitat loss, modification, and, especially, fragmentation are largely responsible for the decline of the American burying beetle resulting in (1) the elimination or reduction of bird species such as the passenger pigeon (*Ectopistes migratorius*), wild turkey (*Meleagris gallopavo*), and greater prairie chicken (*Tympanuchus cupido*) that provide a carrion source; and (2) the increase in competitive scavengers such as the American crow, raccoon, foxes, Virginia opossum, and skunks (FWS 1991b; NJDEP 2005e). Other threats include insecticide and bug-zapper use and disturbance of soils (NatureServe 2005). The American burying beetle is presumed to be extirpated in New Jersey (NJDEP 2005f).

Bog Turtle

The Federally listed threatened bog turtle (*Glyptemys muhlenbergii*, family Emydinae) is one of the smallest of North American turtles, measuring up to 3.9 in. long. It inhabits calcareous fens, sphagnum bogs, and wet, grassy pastures that have soft, muddy substrates and perennial groundwater seepage. Water depths rarely exceed 4 in. deep (NJDEP 2005e). As open areas are favored for basking and nesting, succession may lead to dispersal or loss of bog turtles from an area (NJDEP 2005e). Bog turtles are generally active from April to October. They hibernate in abandoned muskrat houses, burrows, or other natural cavities beneath tussocks or shrub thickets (FWS 2004b). Bog turtles reach maturity at about 8 years of age and can live more than 30 years. They are omnivorous, although the diet is dominated by insects (FWS 2004b; NatureServe 2005). Controlled livestock grazing can create beneficial habitat conditions, while overgrazing can degrade water quality or lead to the growth of undesirable plant species. Linear drainage ditches provide alternative habitats for bog turtles (NJDEP 2005e). Threats to the bog turtle include habitat loss, fragmentation and modification, hydrologic modification, reduced habitat quality due to succession and invasive plant species encroachment, heavy livestock grazing, disturbance or trampling by humans, excessively high raccoon populations, pesticide application for mosquito control, and illegal collecting (FWS 2001; FWS 2004b; NJDEP 2005e; NatureServe 2005). Recent Ocean County occurrences for the bog turtle include Berkeley Township (SJRCDC 2002). Although the bog turtle was not included in the FWS species list for this project (FWS 2005b), the northern portion of the

OCNGS-to-Manitou transmission line right-of-way occurs within this township and crosses habitat that may be suitable for the bog turtle.

Piping Plover

The Federally listed threatened piping plover (*Charadrius melodus*, family Charadriidae) is a small shorebird that inhabits oceanfront beaches and barrier islands. It typically nests on the stretch of beach between the dunes and the high-tide line, often in flat areas with shell fragments and sparse vegetation (NJDEP 2005e). During the nonbreeding season, the piping plover inhabits coastal beaches, barrier islands, inlets, sandflats, mudflats, and dredged-material islands. They forage on invertebrates on intertidal beaches, washover areas, exposed mudflats and sandflats, wracklines, and shorelines (NJDEP 2005e). The Atlantic Coast piping plover breeding population occurs between Newfoundland and southeastern Quebec, south to North Carolina (FWS 2002). It has increased from 790 pairs in 1986 to 1386 pairs in 1999; the number of breeding pairs in New Jersey, however, has remained stable at around 120 pairs (NJDEP 2005e). The piping plover mainly winters from North Carolina to Florida, with some migrating to Mexico and the Caribbean (FWS 2002; NatureServe 2005). Early threats to the piping plover included market hunting and egg collecting. More recent and continuing threats include coastal development, increased recreational use, and increases of mammalian and avian predators. Storm tides may also inundate and destroy nests (FWS 2002; NJDEP 2005e). Habitat for the piping plover does not occur on the OCNGS site or the OCNGS-to-Manitou transmission line right-of-way.

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*, family Accipitridae) is Federally listed as threatened, but proposed for delisting (FWS 1999), and inhabits forested areas that are adjacent to large bodies of water. Bald eagles in New Jersey are mostly associated with the Delaware River and Bay and rivers that flow into the Atlantic Ocean and Delaware Bay (NJDEP 2005e). However, occasionally, transient individuals may occur in the OCNGS area (FWS 2005b). The bald eagle is known to nest in Brick Township (northeastern portion of Ocean County), with historical nesting having occurred in Little Egg Harbor Township (the southern end of the county) (SJRCDC 2002). The bald eagle generally requires a nesting location that is free from human disturbance. A nest tree is typically taller than the trees immediately surrounding it. Foraging habitat consists of large water bodies with nearby large trees for perching. Wintering habitat is similar but requires open, ice-free water (NJDEP 2005e). Portions of the Delaware River and tidal areas of southern New Jersey marshes provide suitable winter foraging areas (NJDEP 2005e).

Historical threats to the bald eagle include habitat destruction, shootings and poisonings, and DDT. By 1970, only one eagle nest remained in New Jersey (NJDEP 2005e). Active management of bald eagles has increased the number of active bald eagle nests statewide (NJDEP 2005e). In 2004, there were 48 eagle pairs during the nesting season, of which 44 were active (had nests with eggs). Thirty-two of the nests were successful in producing 54 young, while 10 nests failed to produce hatchlings because of contaminants and human disturbance (Smith et al. 2004). None of the bald eagle nests were located near OCNGS or within the Barnegat Bay watershed. During the 2004 winter survey, a total of 177 bald eagles were observed in New Jersey. Only 36 were observed along the Atlantic Coast subregion (Smith et al. 2004), and none of these were within the OCNGS area. Ongoing threats to bald eagles in New Jersey include disturbance, habitat destruction, and accumulation of contaminants (Smith et al. 2004).

Roseate Tern

The Federally listed endangered roseate tern (*Sterna dougallii dougallii*, family Sternidae) nests on barrier islands and salt marshes. Nesting colonies are located above the high-tide line often where dense stands of beach grasses and seaside goldenrod (Solidago sempervirens) provide cover. When displaced from optimal breeding sites by gulls, the roseate tern may nest in open areas. The roseate tern forages over shallow coastal waters, inlets, and offshore seas (NJDEP 2005e). Past threats to the roseate tern included killing the birds to obtain their feathers for the millinery trade. Other threats included habitat loss, disturbance, competition from gulls, and predation. The last nesting pair in the State was recorded in 1980 (NJDEP 2005e). No nesting activity or other use of the OCNGS site or vicinity by roseate terns has been recorded.

2.2.7 Radiological Impacts

A radiological environmental monitoring program (REMP) has been conducted around the OCNGS site since 1966. Through this program, radiological impacts on workers, the public, and the environment are monitored, documented, and compared with the appropriate standards. The objectives of the REMP are to assess dose impacts on members of the public from OCNGS operations, to verify in-plant controls for the containment of radioactive materials, to measure accumulation of radioactivity in the environment, to provide reassurance to the public that the program is capable of adequately assessing the impacts and identifying noteworthy changes in the radiological status of the environment, to provide data on measurable levels of radiation and radioactive materials in the site environs, and to evaluate the relationship between quantities of radioactive material released from the plant and resultant radiation doses to individuals from principal pathways of exposure (AmerGen 2005c).

Each year, results of measurements of radiological releases and environmental monitoring are summarized in two annual reports: the OCNGS Annual Radiological Environmental Operating Report (AmerGen 2005c) and the OCNGS Radioactive Effluent Release Report

(AmerGen 2005b). The limits for all radiological releases are specified in the ODCM, and these limits are designed to meet Federal standards and requirements.

The REMP includes monitoring of the concentrations of beta and gamma emitters, iodine, and strontium in the air; concentrations of gamma emitters in surface water, well water, fish, clams, sediment, and vegetation; concentrations of tritium in surface and well water; and direct radiation (gamma dose on thermoluminescent dosimeter locations) (AmerGen 2005c). For trending purposes, radiological and direct radiation measurements are compared with past years. Sampling locations are chosen based on meteorological factors, preoperational planning, and results of land-use surveys. A number of locations, in areas very unlikely to be affected by plant operations, are selected as controls. Monitoring results for the 5-year period of 2000 through 2004 indicate that the radiation and radioactivity in the environmental media monitored around the plant are well within applicable regulatory limits. The only plant-related radionuclide consistently detected is cesium-137 in sediment, a result of historical plant releases and fallout from nuclear weapons testing (AmerGen 2001b, 2002b, 2003c, 2004b, 2005c).

In addition to monitoring radioactivity in environmental media, AmerGen annually assesses doses to the MEIs from gaseous and liquid effluents at several locations based on effluent release data and mathematical modeling methods approved by the NRC. Calculations are performed using the plant effluent release data, onsite meteorological data, and appropriate pathways identified in the ODCM. Radiation dose results for the 5-year period of 2000 through 2004 (AmerGen 2001a, 2002a, 2003b, 2004a, 2005b) were as follows:

- The average total body dose to an individual from all effluents was 2.2×10^{-2} mrem/yr, which is about 0.1 percent of the annual limit of 25 mrem for members of the public specified in the ODCM. Over this period, the maximum annual total body dose to an individual from all effluents was 2.6×10^{-2} mrem/yr, which is also about 0.1 percent of the annual limit of 25 mrem.

- The average dose to the thyroid of an individual from all effluents was 9.4×10^{-2} mrem/yr, which is about 0.1 percent of the annual limit of 75 mrem for the thyroid specified in the ODCM. Over this period, the maximum annual thyroid dose from all effluents was 2.1×10^{-1} mrem/yr, which is about 0.3 percent of the annual limit of 75 mrem.

These results confirm that OCNGS is operating in compliance with 10 CFR Part 50, Appendix I, 10 CFR Part 20, and 40 CFR Part 190. AmerGen does not anticipate any significant changes to the radioactive effluent releases or exposures from OCNGS operations during the renewal period, and, therefore, the impacts on the environment are not expected to change.

In addition to the REMP conducted by AmerGen, the Bureau of Nuclear Engineering, within the NJDEP, operates and maintains an Environmental Surveillance and Monitoring Program (ESMP) for the four nuclear power-generating stations in New Jersey, one of which is OCNGS

(NJDEP 2005h). The purpose of the ESMP is to monitor the various pathways by which people and the environment could be exposed to radiation. All ESMP data are collected at and beyond the site boundaries of the nuclear generating stations. Samples are obtained for the determination of radioactivity in airborne and liquid effluents and in environmental samples such as crops, sediments and soils, and fish. Direct radiation exposure measurements are taken as well. Historically, the results of the ESMP are consistent with those collected by the REMP (NJDEP 2006b).

2.2.8 Socioeconomic Factors

The NRC staff reviewed the AmerGen ER (2005a) and information obtained from county, city, school district, and local economic development staff. The following sections describe the housing market, community infrastructure, population, and economy in the region surrounding the OCNGS site.

2.2.8.1 Housing

The majority (81 percent) of OCNGS employees live in Ocean County; most of the remaining employees are located in Monmouth and Burlington Counties (Table 2-6). Given the residential location of OCNGS employees, the most significant impacts of plant operations are likely to occur in Ocean County. The focus of the analysis in this SEIS is on the impacts of OCNGS operations in this county.

OCNGS employs a permanent workforce of approximately 470 employees. AmerGen refuels OCNGS every 24 months. During refueling, approximately 1300 additional workers are employed for a 20-day period (AmerGen 2005a). The majority of these temporary workers reside in the same communities as the permanent employees at the plant (AmerGen 2005a).

The number of housing units and housing vacancies in Ocean County are shown in Table 2-7. The total number of housing units in the county grew at an annual rate of 1.2 percent over the period 1990 to 2000, while the number of occupied units grew at an average annual rate of 1.8 percent over the same period. With an annual average population growth rate of almost 1.7 percent during this period, there was a slight decline (–0.7 percent) in the annual rate of growth in the number of vacant units during this period.

Table 2-6. OCNGS Permanent Employee Residence Information by County and City

City and County[a]	Percent of Total
OCEAN COUNTY	
Forked River	15.5
Barnegat	14.9
Toms River	12.4
Tuckerton	7.4
Lanoka Harbor	6.0
Manahawkin	5.4
Others	19.0
Total Ocean County	80.6
Other counties	19.4
Grand total	100

(a) Addresses are for both unincorporated (county) and incorporated (cities and towns) areas.
Source: NRC 2006a

Table 2-7. Housing Units and Housing Units Vacant (Available) in Ocean County During 1990 and 2000

	1990	2000	Percentage Change 1990 to 2000
Housing units	219,863	248,711	13.1
Occupied units	168,147	200,402	19.2
Vacant units	51,716	48,309	–6.6

Source: USCB 2005a

2.2.8.2 Public Services

Water Supply

Water supplies in Ocean County come primarily from groundwater sources (Table 2-8). Currently, the county has 20 water suppliers, with four suppliers providing 76 percent of total capacity. In 1985, the New Jersey Water Supply Administration (NJWSA) created two Water Supply Critical Areas to regulate all groundwater or surface-water diversions in excess of

10,000 gpd in order to protect deep aquifers from the intrusion of salt water (AmerGen 2005a). Since 1989, when restrictions on withdrawals from deep aquifers and the substitution of water from shallow aquifers and surface water began to take effect, deep aquifers have partially recovered (AmerGen 2005a). All the water supply systems in the county have additional capacity to meet new water demands (AmerGen 2005a).

OCNGS withdraws water from two wells located onsite at a rate of 14 gpm; the capacity of these wells is 425 gpm (AmerGen 2005a). The plant does not use groundwater from local municipal systems. Fire protection for the plant is provided by the Forked River Fire Company and the Lanoka Harbor Fire Company (Township of Lacey 2005).

Education

OCNGS is located in the Lacey Township Public School District, which had a total enrollment of 4224 students in 2003 (Public School Review 2005). There are 282 teachers currently

Table 2-8. Major Public Water Supply Systems in Ocean County in 2004

Water System[(a)]	Source	Average Daily Use (million gpd)	Maximum Capacity (million gpd)
United Water – Toms River	Groundwater	12.3	30.2
Brick Township MUA	Surface water	9.2	47.3
New Jersey American Water Company – Lakewood	Surface water	3.0	7.9
New Jersey American Water Company – Ocean City	Groundwater	2.8	12.2
Jackson Township MUA	Groundwater	2.5	11.0
Lakewood Township MUA	Groundwater	2.0	2.2
Manchester Township MUA	Groundwater	1.9	7.6
Lacey Township MUA	Groundwater	1.9	7.2
Stafford Township MUA	Groundwater	1.4	0.9
Crestwood Village Water Company	Groundwater	1.4	6.1
Little Egg Harbor	Groundwater	1.3	6.0
Point Pleasant	Groundwater	1.0	4.7
Long Beach Township	Groundwater	1.0	7.5

(a) MUA = Municipal Utilities Authority.
Source: AmerGen 2005a

employed in the district (Public School Review 2005), and expenditures are currently $8661 per student (Standard and Poor's 2005). Enrollment has grown in recent years, together with expenditures per student, while the number of teachers in the district has remained stable over the same period (Standard and Poor's 2005; Public School Review 2005).

Including the Lacey Township Public School District, there are 20 public school districts in Ocean County, which had a total enrollment in 2003 of 79,175 students (Public School Review 2005). Average expenditure per student in the public school districts in the county is $11,533, compared with $13,173 for New Jersey as a whole in 2003 (Standard and Poor's 2005). There were an additional 62 private schools in the county in 2004, with an enrollment of 13,702 students, and one vocational school (NCES 2005).

Transportation

Access to OCNGS is via U.S. Highway 9, approximately 1.0 mi east of the plant. Highway 9 runs parallel to the Garden State Parkway. Both roads are intersected by Lacey Road, to the north of the site, and Warren Grove Road to the south. Most OCNGS employees traveling from the northern and southern parts of Ocean County use these roads to reach the site (AmerGen 2005a).

Moderate increases in traffic have occurred on many of the roads in the vicinity of the plant, in particular on the Garden State Parkway and Highway 9, which have seen large increases in commuter and commercial traffic. One segment of Highway 9 for which traffic counts are available were assessed in the ER (AmerGen 2005a). This segment extends from the north of the plant as far as Beachwood. Traffic conditions on most of this road segment vary between medium density, stable flow during off-peak hours, to high capacity traffic, where congestion is likely at a number of intersections during rush hours (AmerGen 2005a).

2.2.8.3 Offsite Land Use

Ocean County occupies an area of 638 mi^2. Land use in the county is primarily forest (45 percent of total land area), recreation (16 percent), and government (16 percent), with a smaller land area occupied by residential (7 percent), industrial (3 percent), and commercial land uses (1 percent) (Table 2-9).

Located close to the large metropolitan centers of New York and northern New Jersey, land in the county has come under increasing development pressure, with rapid increases in population resulting from the suburbanization of the New York and New Jersey metropolitan population. The county is popular as a retirement location, which has also increased the demand for land in the county. The county is also a popular recreation and tourism destination, activities that

Table 2-9. Land Use in Ocean County

Land Use	Percent of Total
Forest	45
Recreation	16
Government	16
Vacant	10
Residential	7
Industrial	3
Commercial	1
Agriculture	1
Other	1
Total	100

Source: OCPB 1988

provide a significant source of employment and income in Ocean County. Barnegat Bay and the coastal shoreline, parks, and recreational areas are strong attractions for summer and fall visitors and seasonal residents; a relatively large proportion of land area in the county is devoted to public and semipublic uses. The Federal government also has a large presence in the county at the Lakehurst Naval Air Engineering Center and Fort Dix, both located in the northwestern part of the county (OCPB 1988; OCDP 2005a).

Residential, commercial, and industrial development in the county has mainly occurred along the Garden State Parkway and along U.S. Highway 9, particularly in the Toms River and Lacey Township areas. Competition for land, especially for land in lakefront locations for summer and retirement homes, has been intense in recent years. As a result of these developments, both the coastal shoreline and older residential and farmland areas in the county are confronting severe growth pressure.

Recognizing the importance of balanced residential and commercial development and the importance of environmental protection, Ocean County developed a series of planning goals and objectives in its Comprehensive Master Plan (OCPB 1988). Under this plan, the county provides support in a number of program areas, including the coordination of the road transportation network, public transit system, and low-income housing, and also provides support to other entities, such as businesses considering locations within the county.

Although the county plays a wide-ranging role in coordinating resources for the management of growth, land-use planning and the control of commercial and residential growth in the county are primarily the concern of individual townships. Lacey Township, for example, in the 1991

Township of Lacey Master Plan (Township of Lacey 1991) recognized that residential and commercial growth would continue to occur in the township and established the township as a provider of infrastructure and services to facilitate orderly growth. As part of the process of managing growth, the Master Plan intends that the township provide contiguous land areas to compatible users while protecting the environment, encourage residential development of appropriate density, protect the aesthetic character of the township, and maintain navigable waterways (Township of Lacey 1991).

Ocean County has large amounts of land protected from development, with large tracts of land in State Parks, State Forests, Wildlife Management Areas, the Forsythe National Wildlife Refuge, and various county parks. Large parts of Ocean County and Lacey Township lie within the Pinelands National Reserve, a large area of protected pine forest in the southeastern part of the State (AmerGen 2005a). The Pinelands Protection Act is intended to protect the Pinelands region from severe development pressure. Under the provisions of the Act, county and municipal master plans and land-use ordinances must conform to the Pinelands Comprehensive Management Plan, which places restrictions on the density of various land uses within the region (OCPB 1988). Under the Ocean County Natural Lands Trust Funds Program established in 1997, the county can acquire land for conservation and farmland preservation, with almost 7000 ac preserved in the northern part of the county under this program (OCDP 2005b). The NJDEP also regulates land use in the county, applying New Jersey Coastal Permit Program rules and Coastal Zone Management Act rules to determine how State laws, including the Coastal Area Facility Review Act, the Waterfront Development Law, the Wetlands Act, and the Tidelands Act, are used to control development in coastal areas (NJDEP 2005c). Barnegat Bay and Little Egg Harbor, which stretch the entire length of the county, are protected under the National Estuary Program (OCDP 2005b).

2.2.8.4 Visual Aesthetics and Noise

OCNGS is located 2 mi inland from Barnegat Bay. The plant has a once-through cooling system that draws cooling water from Barnegat Bay, and no cooling towers are used. The New Jersey shoreline in Ocean County attracts summer tourists and seasonal residents who enjoy the recreational and environmental attractions of the area.

The OCNGS site is 800 ac of mostly open and wooded land. Plant buildings include a rectangular turbine building (88 ft high); a rectangular reactor containment building (119 ft high); a rectangular waste storage building (44 ft high); and a single stack (368 ft high) (AmerGen 2003a). The plant stack and buildings can be readily seen from most directions, including from Highway 9, the Garden State Parkway, Seaside Park, NJ, and the Barnegat Bay shoreline. The transmission lines connected to the OCNGS substation can also be readily seen from all directions, including from both Highway 9 and the Garden State Parkway.

Noise measurements are not available for the OCNGS site. However, noise generated by OCNGS operations is mitigated at the nearest offsite receptor because the plant is buffered by undeveloped land along the Forked River to the north of the site and Oyster Creek to the south. Between the river and creek, the plant is buffered toward the east by a small wooded area along the length of Highway 9, thus reducing the conspicuousness of any noise generated by OCNGS operations. Most equipment is located within the plant buildings. Higher noise levels are created on the first Saturday of each month when onsite and offsite warning sirens are tested.

2.2.8.5 Demography

In 2000, 434,476 people were living within 20 mi of OCNGS, resulting in a density of 610 persons/mi^2. This density translates to Category 4 (*least sparse* – greater than or equal to 120 persons/mi^2 within 20 mi), using the GEIS measure of sparseness (AmerGen 2005a). At the same time, 4,243,462 persons were living within 50 mi of the plant, for a density of 1132 persons/mi^2. This density is given a Category 4 rating (*in close proximity* – greater than or equal to 190 persons/mi^2 within 50 mi) for proximity. Although there are no growth controls that would limit housing development in this area, planning goals and objectives at the county and township levels encourage balanced residential and commercial development (see Section 2.2.3.3 of this SEIS) (NRC 2006b,c).

Table 2-10 shows population trends for Ocean County, where the majority of OCNGS employees live. Annual average growth rates in Ocean County show rapid growth during the

Table 2-10. Population Growth in Ocean County, 1970 to 2020

Year	Population	Annual Growth (Percent)[a]
1970	208,470	–[b]
1980	346,038	5.2
1990	433,203	2.3
2000	510,916	1.7
2010	593,300	1.5
2020	677,000	1.3

(a) Annual percent growth rate is calculated over the previous decade.
(b) – = no data available.
Source: AmerGen 2005a

1970s and 1980s, followed by moderate increases during the 1990s. The annual average growth rate in New Jersey over the period 1990 to 2000 was 0.9 percent. Growth is forecasted to continue at moderate levels over the period 2000 to 2020.

Transient Population

The transient population in the vicinity of the OCNGS site consists primarily of tourists visiting the Toms River area and the various recreational facilities in this area (AmerGen 2005a). It is estimated that peak visitation levels associated with campgrounds and beaches in the area reach almost 500,000 (BBNEP 2005). People visiting summer homes and attendance at local colleges in the area also represent a substantial portion of the transient population in the area.

Migrant Farm Labor

Although seasonal or migrant workers are employed during the summer and fall months in the area around the plant, the majority of agricultural laborers reside in the area (AmerGen 2005a). Only a small number of seasonal migrant agricultural workers reside in Ocean County, where agriculture is less important to the county economy than it is in adjacent counties.

2.2.8.6 Economy

Employment and Income

Total employment in Ocean County was 119,759 in 2002 (USCB 2005b). Service industries dominate employment in the county with almost 53 percent of total employment (63,195 people employed). The largest employer within 10 mi of the plant is the Saint Barnabas Health Care System, which has 4600 employees countywide (Table 2-11). Wholesale and retail trade also plays an important part in the local economy, with more than 25 percent of local employment (30,413 people). Manufacturing employs only 6 percent (6767 people) of the county workforce. Personal income in Ocean County was $17.8 billion in 2003 (in 2004 dollars), with a per capita income of $33,883 (2004 dollars) (DOC 2005).

Unemployment

Unemployment in Ocean County was moderately high at 4.9 percent in 2004 (DOL 2005). The unemployment rate for New Jersey as a whole in 2004 was 4.8 percent.

Taxes

Property taxes are paid by OCNGS to Lacey Township, Ocean Township, and Ocean County. Lacey Township and Ocean Township collect tax revenues from the plant to cover local

Table 2-11. Major Employers Within 10 mi of the OCNGS Site

Firm	Number of Employees
Saint Barnabas Health Care System	4600
Lakewood Naval Air Warfare Center	3437
Toms River Regional School System	2235
Ocean County Government	1964
Southern Ocean County Hospital	1056
Dover Township Municipal Government	837
Lacey Township Board of Education	736
Ocean County College	712
Health South Rehabilitation Hospital	500
Southern Regional School District	500
AmerGen Energy Company, LLC	450

Source: OCDP 2005a

expenditures and forward the balance to the county. A large majority (99 percent) of the initial OCNGS payment is made to Lacey Township. Revenues are used by each taxing entity to fund local and county emergency management programs, public safety, local public schools, local government operations, local road maintenance, and the local library system.

The plant is not a significant source of tax revenue for local and county government. Over the period 2002 to 2004, on average, approximately 4 percent (about $1.9 million in 2004 dollars) of annual tax revenues spent in Lacey Township came from OCNGS property taxes (Table 2-12). About 1 percent (about $100,000 in 2004 dollars) of Ocean Township annual tax revenues, on average, over the period 2002 to 2004 came from OCNGS.

Utility restructuring legislation has been in place in New Jersey since 1997. However, the long-term impact of the restructuring of the electric power industry in the State and its impact on OCNGS are not yet known. Any changes in assessed valuation of plant property and equipment that may potentially occur could affect property tax payments to the townships and the county. However, any impacts on tax revenues as a result of restructuring would not occur as a direct result of license renewal.

Table 2-12. OCNGS Contribution to Lacey Township Tax Revenues

Year	Total Lacey Township Tax Revenues (millions $ 2004)	Property Tax Paid to Lacey Township for OCNGS (millions $ 2004)	Percent of Total Tax Revenues
2002	42.6	1.8	4.1
2003	46.2	1.9	4.1
2004	48.3	1.9	3.9

(a) Sources: AmerGen 2005a; NRC 2006d.

2.2.9 Historic and Archaeological Resources

This section discusses the cultural background and the known historic and archaeological resources at the OCNGS site and in the surrounding area.

2.2.9.1 Cultural Background

The area in and around the OCNGS site has the potential for significant prehistoric and historic resources. Many sites (shell middens and small camps) have been recorded within the New Jersey Pinelands and to the north, in the vicinity of OCNGS (Section 2.2.9.2). Human occupation in this region roughly follows a standard chronological sequence for prehistory in the Eastern United States: Paleo-Indian Period (13000 BC to 8000 BC); Archaic Period (8000 BC to 1000 BC); Woodland Period (1000 BC to AD 1600). In general, the Paleo-Indian Period is characterized by highly mobile bands of hunters and gatherers. A typical Paleo-Indian site might consist of an isolated stone point or knife (of a style characteristic of the period) in an upland area along large river valleys or ancient lake beds. The Archaic Period represents a transition from a highly mobile existence to a more sedentary existence. It is a period of increased local resource exploitation (e.g., predominantly deer and small mammals, fish, and other aquatic resources, nuts, and seeds), more advanced tool development, and increased complexity in social organization. The Woodland Period is a continuation of the complexities begun during the Archaic Period with the introduction of ceramic technology. Pottery, the principal distinguishing feature between Archaic and Woodland period sites, begins to appear in the archaeological record during this time. Generally, the Woodland people lived in wood and bark dwellings in small permanent or semipermanent settlements.

The historic period in this region began with the arrival of the first European settlers in the mid-1600s. However, the earliest accounts of Europeans arriving in Ocean County are of Giovanni da Verrazano in 1524 and Henry Hudson in 1609. At that time, the Late Woodland people who were first contacted called themselves the “Lenape.” Historic Native American nations and Tribes known to have inhabited this region include the Delaware, the Lenni-Lenape, and the Mohicans.

Ocean County has 27 sites listed on the National Register of Historic Places; 5 of these properties are located within approximately 6 mi of the OCNGS Site: Barnegat City Public School (Barnegat Light Museum), Barnegat Lighthouse, Double Trouble State Park Historic District, Falkinburg Farmstead, and Manahawkin Baptist Church. Nearly 100 additional properties in Ocean County have been identified as State Historic Preservation Office-opinion eligible, including the Garden State Parkway Historic District, which includes the entire Garden State Parkway right-of-way; some of those properties have been listed on the New Jersey State Register of Historic Places (NJDEP 2006c).

2.2.9.2 Historic and Archaeological Resources at the OCNGS Site

The OCNGS site occupies approximately 800 acres. In addition, 320 ac of land along 11.1 mi of right-of-way are occupied by the OCNGS-to-Manitou transmission line (AmerGen 2005a). Approximately 20 percent (150 ac) of the OCNGS site was disturbed by construction of the nuclear power plant facilities and related infrastructure, including roads and parking lots. The remaining 80 percent (650 ac) is the former Finninger Farm property (previously used as a cattle farm), most of which is undeveloped and relatively undisturbed. Portions of the Finninger Farm were disturbed by canal dredging operations, including a relatively recent 17.5-ac dredge spoils area with bermed containment. Intact archaeological sites could be present within the undeveloped areas of the farm. Some previous disturbance has also occurred along the transmission line corridor.

No archaeological surveys were completed at the OCNGS site prior to station construction (AEC 1974). However, during the site visit (October 2005), a review of NJDEP site files identified 20 sites recorded within the vicinity of the Forked River and Oyster Creek. These sites, predominantly prehistoric middens and surface sites, were recorded as part of the Pinelands Prehistoric Archaeological Resources Inventory in 1980 (NJPC 2005). The inventory was based on the work of archaeologists and amateur collectors in the area. One of these sites may be located on the Finninger Farm property.

Although no known sites of significance to Native Americans have been identified at the OCNGS site, the appropriate Federally recognized Native American Tribes have been contacted and asked to participate in the NEPA review (Appendix E).

2.2.10 Related Federal Project Activities and Consultations

The NRC staff reviewed the possibility that activities of other Federal agencies might impact the renewal of the OL for OCNGS. Any such activities could result in cumulative environmental impacts and the possible need for the Federal agency to become a cooperating agency for preparation of this SEIS.

The NRC staff has determined that there are no Federal project activities that would make it desirable for another Federal agency to become a cooperating agency for preparing this SEIS. Federally owned facilities within 50 mi of OCNGS are the Lakehurst Naval Air Engineering Center and Fort Dix, both located in the northwestern part of Ocean County; the Edwin B. Forsythe National Wildlife Refuge in Atlantic County; and the Naval Weapons Station in Monmouth County. There are no Native American lands within 50 mi of OCNGS.

The NRC is required under Section 102(c) of the National Environmental Policy Act to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved. The NRC has consulted with the FWS and NMFS on threatened and endangered species and with the NMFS on EFH. The consultations are described in Sections 2.2.5.5, 2.2.6.2, 4.6, and 4.7. Correspondence regarding these consultations and NRC's EFH assessment are included in Appendix E.

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10 CFR Part 54. *Code of Federal Regulations*, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

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40 CFR Parts 9, 122 et al. Code of Federal Regulations, Title 40, Protection of Environment, Part 122, "EPA Administered Permit Programs: The National Pollutant Discharge Elimination System."

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3.0 Environmental Impacts of Refurbishment

Environmental issues associated with refurbishment activities are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required in this draft Supplemental Environmental Impact Statement (SEIS) unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1 and, therefore, additional plant-specific review of these issues is required.

License renewal actions may require refurbishment activities for the extended plant life. These actions may have an impact on the environment that requires evaluation, depending on the type of action and the plant-specific design. Environmental issues associated with refurbishment that were determined to be Category 1 issues are listed in Table 3-1.

Environmental issues related to refurbishment considered in the GEIS for which these conclusions could not be reached for all plants, or for specific classes of plants, are Category 2 issues. These are listed in Table 3-2.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

Table 3-1. Category 1 Issues for Refurbishment Evaluation

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
SURFACE-WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)	
Impacts of refurbishment on surface-water quality	3.4.1
Impacts of refurbishment on surface-water use	3.4.1
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Refurbishment	3.5
GROUNDWATER USE AND QUALITY	
Impacts of refurbishment on groundwater use and quality	3.4.2
LAND USE	
Onsite land use	3.2
HUMAN HEALTH	
Radiation exposures to the public during refurbishment	3.8.1
Occupational radiation exposures during refurbishment	3.8.2
SOCIOECONOMICS	
Public services: public safety, social services, and tourism and recreation	3.7.4; 3.7.4.3; 3.7.4.4; 3.7.4.6
Aesthetic impacts (refurbishment)	3.7.8

Category 1 and Category 2 issues related to refurbishment that are not applicable to Oyster Creek Nuclear Generating Station (OCNGS) because they are related to plant design features or site characteristics not found at OCNGS are listed in Appendix F.

The potential environmental effects of refurbishment actions would be identified, and the analysis would be summarized within this section, if such actions were planned. AmerGen Energy Company, LLC (AmerGen), indicated that it has performed an integrated plant assessment evaluating structures and components pursuant to Title 10, Part 54, Section 54.21, of the *Code of Federal Regulations* (10 CFR 54.21) to identify activities that are necessary to continue operation of OCNGS during the requested 20-year period of extended operation. These activities include replacement of certain components, as well as new inspection activities, and are described in the Environmental Report (ER) (AmerGen 2005).

Table 3-2. Category 2 Issues for Refurbishment Evaluation

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53 (c)(3)(ii) Subparagraph
TERRESTRIAL RESOURCES		
Refurbishment impacts	3.6	E
THREATENED OR ENDANGERED SPECIES (FOR ALL PLANTS)		
Threatened or endangered species	3.9	E
AIR QUALITY		
Air quality during refurbishment (nonattainment and maintenance areas)	3.3	F
SOCIOECONOMICS		
Housing impacts	3.7.2	I
Public services: public utilities	3.7.4.5	I
Public services: education (refurbishment)	3.7.4.1	I
Offsite land use (refurbishment)	3.7.5	I
Public services: transportation	3.7.4.2	J
Historic and archaeological resources	3.7.7	K
ENVIRONMENTAL JUSTICE		
Environmental justice	Not addressed[a]	Not addressed[a]

(a) Guidance related to environmental justice was not in place at the time the GEIS and the associated revision to 10 CFR Part 51 were prepared. If an applicant plans to undertake refurbishment activities for license renewal, environmental justice must be addressed in the applicant's ER and the U.S. Nuclear Regulatory Commission staff's environmental impact statement.

The integrated plant assessment that AmerGen conducted under 10 CFR Part 54 did not identify the need to undertake any major refurbishment or replacement actions to maintain the functionality of important systems, structures, and components during the OCNGS license renewal period. Therefore, refurbishment is not considered in this draft SEIS.

3.1 References

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

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U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report*, "Section 6.3 – Transportation, Table 9.1, Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants, Final Report." NUREG-1437, Vol. 1, Addendum 1, Washington, D.C.

4.0 Environmental Impacts of Operation

Environmental issues associated with operation of a nuclear power plant during the renewal term are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issues could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required.

This chapter addresses the issues related to operation during the renewal term that are listed in Table B-1 of Title 10, Part 51, of the *Code of Federal Regulations* (10 CFR Part 51), Subpart A, Appendix B, and are applicable to the Oyster Creek Nuclear Generating Station (OCNGS). Section 4.1 addresses issues applicable to the OCNGS cooling system. Section 4.2 addresses issues related to transmission lines and onsite land use. Section 4.3 addresses the radiological impacts of normal operation, and Section 4.4 addresses issues related to the socioeconomic impacts of normal operation during the renewal term. Section 4.5 addresses issues related to groundwater use and quality, while Section 4.6 discusses the impacts of renewal-term operations on threatened and endangered species. Section 4.7 addresses potential new information that was raised during the scoping period, and Section 4.8 discusses cumulative

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(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

impacts. The results of the evaluation of environmental issues related to operation during the renewal term are summarized in Section 4.9. Category 1 and Category 2 issues that are not applicable to OCNGS because they are related to plant design features or site characteristics not found at OCNGS are listed in Appendix F.

4.1 Cooling System

Category 1 issues in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, that are applicable to OCNGS cooling-system operation during the renewal term are listed in Table 4-1. AmerGen Energy Company, LLC (AmerGen), stated in its Environmental Report (ER) (AmerGen 2005a) that it is not aware of any new and significant information associated with the renewal of the OCNGS operating license (OL). The U.S. Nuclear Regulatory Commission (NRC) staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of the category 1 issues, the NRC staff concluded in the GEIS that the impacts would be SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the NRC staff's review and the GEIS conclusions, as codified in 10 CFR Part 51, Table B-1, for each of these issues follows:

- <u>Altered current patterns at intake and discharge structures</u>. Based on information in the GEIS, the Commission found that

  > Altered current patterns have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. During the scoping meeting on November 1, 2005, a member of the public raised an issue concerning excessive sediment deposition at the mouths of the finger canals along the Forked River. Station operation may contribute to the deposition of sediment in the canals. This issue is addressed in Section 4.7 of this Supplemental Environmental Impact Statement (SEIS), but it was not considered new and significant information. The NRC staff concludes that there would be no impacts of altered current patterns at intake and discharge structures during the renewal term beyond those discussed in the GEIS.

Table 4-1. Category 1 Issues Applicable to the Operation of the OCNGS Cooling System During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
SURFACE-WATER QUALITY, HYDROLOGY, AND USE	
Altered current patterns at intake and discharge structures	4.2.1.2.1
Altered salinity gradients	4.2.1.2.2
Temperature effects on sediment transport capacity	4.2.1.2.3
Scouring caused by discharged cooling water	4.2.1.2.3
Eutrophication	4.2.1.2.3
Discharge of chlorine or other biocides	4.2.1.2.4
Discharge of sanitary wastes and minor chemical spills	4.2.1.2.4
Discharge of other metals in wastewater	4.2.1.2.4
Water-use conflicts (plants with once-through cooling systems)	4.2.1.3
AQUATIC ECOLOGY	
Accumulation of contaminants in sediments or biota	4.2.1.2.4
Entrainment of phytoplankton and zooplankton	4.2.2.1.1
Cold shock	4.2.2.1.5
Thermal plume barrier to migrating fish	4.2.2.1.6
Distribution of aquatic organisms	4.2.2.1.6
Gas supersaturation (gas bubble disease)	4.2.2.1.8
Low dissolved oxygen in the discharge	4.2.2.1.9
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.2.2.1.10
Stimulation of nuisance organisms	4.2.2.1.11
HUMAN HEALTH	
Noise	4.3.7

- Altered salinity gradients. Based on information presented in the GEIS, the Commission found that

  > Salinity gradients have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of altered salinity gradients during the renewal term beyond those discussed in the GEIS.

- Temperature effects on sediment transport capacity. Based on information in the GEIS, the Commission found that

  > These effects have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of temperature effects on sediment transport capacity during the renewal term beyond those discussed in the GEIS.

- Scouring caused by discharged cooling water. Based on information in the GEIS, the Commission found that

  > Scouring has not been found to be a problem at most operating nuclear power plants and has caused only localized effects at a few plants. It is not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, the review of monitoring programs, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of scouring caused by discharged cooling water during the renewal term beyond those discussed in the GEIS.

- Eutrophication. Based on information on eutrophication in the GEIS, the Commission found that

  > Eutrophication has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, the review of monitoring programs, or the evaluation of other available information, including plant monitoring data and technical reports. Therefore, the NRC staff concludes that there would be no impacts of eutrophication during the renewal term beyond those discussed in the GEIS.

- Discharge of chlorine or other biocides. Based on information in the GEIS, the Commission found that

  > Effects are not a concern among regulatory and resource agencies, and are not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information, including the New Jersey Pollutant Discharge Elimination System (NJPDES) permit for OCNGS, or discussion with the New Jersey Department of Environmental Protection (NJDEP). Therefore, the NRC staff concludes that there would be no impacts of discharge of chlorine or other biocides during the renewal term beyond those discussed in the GEIS.

- Discharge of sanitary wastes and minor chemical spills. Based on information in the GEIS, the Commission found that

  > Effects are readily controlled through NPDES permit and periodic modifications, if needed, and are not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information, including the NJPDES permit for OCNGS, or discussion with the NJDEP. Therefore, the NRC staff concludes that there would be no impacts of discharges of sanitary wastes and minor chemical spills during the renewal term beyond those discussed in the GEIS.

- <u>Discharge of other metals in wastewater</u>. Based on information in the GEIS, the Commission found that

  > These discharges have not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems and have been satisfactorily mitigated at other plants. They are not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information, including the NJPDES permit for OCNGS, or discussion with the NJDEP. Therefore, the NRC staff concludes that there would be no impacts of discharges of other metals in wastewater during the renewal term beyond those discussed in the GEIS.

- <u>Water-use conflicts (plants with once-through cooling systems)</u>. Based on information in the GEIS, the Commission found that

  > These conflicts have not been found to be a problem at operating nuclear power plants with once-through heat dissipation systems.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of water-use conflicts for plants with once-through cooling systems during the renewal term beyond those discussed in the GEIS.

- <u>Accumulation of contaminants in sediments or biota</u>. Based on information in the GEIS, the Commission found that

  > Accumulation of contaminants has been a concern at a few nuclear power plants but has been satisfactorily mitigated by replacing copper alloy condenser tubes with those of another metal. It is not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of available information. In the mid-1970s, the owners of the OCNGS replaced the Admiralty brass condenser tubes with condenser tubes made of titanium. Therefore, the NRC staff concludes that there would be no impacts of accumulation of contaminants in sediments or biota during the renewal term beyond those discussed in the GEIS.

- Entrainment of phytoplankton and zooplankton. Based on information in the GEIS, the Commission found that

    Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, the review of monitoring programs, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no problems associated with the entrainment of phytoplankton and zooplankton during the renewal term beyond those discussed in the GEIS.

- Cold shock. Based on information in the GEIS, the Commission found that

    Cold shock has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems, has not endangered fish populations or been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds, and is not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information, including the NJPDES permit for OCNGS. The NJPDES permit for OCNGS stipulates that OCNGS not schedule routine shutdowns during the months of December, January, February, or March to reduce the possibility of cold shock. Despite this, three recent cold-shock incidents have been recorded at OCNGS during plant shutdowns. In these cases, warmwater fish species occupying the warm waters of the discharge area died from cold shock when unplanned shutdowns occurred. Cold-shock related fish kills occurred in 2000, 2001, and 2006. Of the 3547 fish killed on January 21, 2000, 84 percent were striped bass (*Morone saxatilis*). On November 11, 2001, 98 percent of the 1407 fish killed were warmwater species [crevalle jacks (*Caranx hippos*), blue runners (*Caranx crysos*), and lookdowns (*Selene vomer*)]. On January 25, 2006, OCNGS reduced power by 50 percent due to a recirculation pump failure. On January 28, OCNGS ceased power production completely, and dead fish were observed in the discharge canal from January 29 to February 3. Of the 80 dead fish observed, 78 were bluefish (*Pomatomus saltatrix*) (AmerGen 2006).

  The number of fish killed during these infrequent events is not considered large enough to either destabilize or noticeably alter any important attribute of the resource. Based on the operating history of OCNGS, the NRC staff concludes that the impacts of cold shock are consistent with those described in the GEIS. Such impacts would be minor and would have no detectable impact on Barnegat Bay fish resources.

- Thermal plume barrier to migrating fish. Based on information in the GEIS, the Commission found that

  > Thermal plumes have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of thermal plume barriers on migrating fish during the renewal term beyond those discussed in the GEIS.

- Distribution of aquatic organisms. Based on information in the GEIS, the Commission found that

  > Thermal discharge may have localized effects but is not expected to affect the larger geographical distribution of aquatic organisms.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, the review of monitoring programs, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts on the distribution of aquatic organisms during the renewal term beyond those discussed in the GEIS.

- Gas supersaturation (gas bubble disease). Based on information in the GEIS, the Commission found that

  > Gas supersaturation was a concern at a small number of operating nuclear power plants with once-through cooling systems but has been satisfactorily mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of gas supersaturation during the renewal term beyond those discussed in the GEIS.

- <u>Low dissolved oxygen in the discharge</u>. Based on information in the GEIS, the Commission found that

> Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system but has been effectively mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, the review of monitoring programs, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of low dissolved oxygen during the renewal term beyond those discussed in the GEIS.

- <u>Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses</u>. Based on information in the GEIS, the Commission found that

> These types of losses have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of losses from predation, parasitism, and disease among organisms exposed to sublethal stresses during the renewal term beyond those discussed in the GEIS.

- <u>Stimulation of nuisance organisms</u>. Based on information in the GEIS, the Commission found that

> Stimulation of nuisance organisms has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where previously it was a problem. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term.

The single nuclear power plant referred to above is OCNGS. The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. During the 1970s and 1980s, four wood-boring teredinid species were observed in Barnegat Bay. Two species (*Bankia gouldi* and *Teredo navalis*) are common to the bay, and two species (*T. bartschi* and *T. fucifera*) are native to tropical and subtropical regions, but were likely introduced to the bay and became established in the areas affected by thermal discharges of OCNGS. According to the Barnegat Bay National Estuary Program (BBNEP) (2001), the two tropical species are no longer found in the estuary. It is likely that the prevalence of the other species has also decreased because of the removal and replacement of wooden structures with other materials. Therefore, the NRC staff concludes that there would be no impacts of stimulation of nuisance organisms during the renewal term beyond those discussed in the GEIS.

- Noise. Based on information in the GEIS, the Commission found that

  > Noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of noise during the renewal term beyond those discussed in the GEIS.

The Category 2 issues related to cooling-system operation during the renewal term that are applicable to OCNGS are discussed in the sections that follow and are listed in Table 4-2.

4.1.1 Entrainment of Fish and Shellfish in Early Life Stages

For power plants with once-through cooling-systems, the entrainment of fish and shellfish in early life stages by nuclear power plant cooling systems is considered a Category 2 issue that requires plant-specific assessment for license renewal. The NRC staff independently reviewed the AmerGen ER (AmerGen 2005a), visited the site, and reviewed the applicant's current NJPDES permit and the NJDEP fact sheet describing the OCNGS draft permit and the permit renewal process (NJDEP 2005). The NRC staff also reviewed relevant scientific articles and compilations associated with the study area, documents and technical reports from NJDEP and its contractor (Versar, Inc.), the National Marine Fisheries Service (NMFS), the U.S. Geological Survey, and the BBNEP. The NRC staff also spoke to scientists at Rutgers University who have conducted research in Barnegat Bay.

Table 4-2. Category 2 Issues Applicable to the Operation of the OCNGS Cooling System During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR Part 51.53(c)(3)(ii) Subparagraph	SEIS Section
AQUATIC ECOLOGY			
Entrainment of fish and shellfish in early life stages	4.2.2.1.2	B	4.1.1
Impingement of fish and shellfish	4.2.2.1.3	B	4.1.2
Heat shock	4.2.2.1.4	B	4.1.3

Section 316(b) of the Clean Water Act (CWA) (Title 33, Section 1326, of the *United States Code* [33 USC 1326]) requires that the location, design, construction, and capacity of the cooling-water intake structures reflect the best technology available for minimizing adverse environmental impacts. Entrainment of fish and shellfish into the cooling-water system is a potential adverse environmental impact.

On July 9, 2004, the EPA published a final rule in the *Federal Register* (69 FR 41575) addressing cooling-water intake structures with flow levels exceeding a minimum threshold value of 50 million gallons per day (gpd) at existing power plants. The rule is Phase II in the EPA's development of 316(b) regulations that establish national requirements applicable to the location, design, construction, and capacity of cooling-water intake structures at existing facilities that exceed the threshold value for water withdrawals. The national requirements, which are implemented through National Pollutant Discharge Elimination System (NPDES) permits, are designed to minimize the adverse environmental impacts, including entrainment losses, associated with the continued use of the intake systems. The new performance standards are designed to significantly reduce entrainment losses resulting from plant operation. Licensees are required to demonstrate compliance with the Phase II performance standards at the time of renewal of their NPDES permit. As part of the NPDES renewal, licensees may be required to alter the intake structure, redesign the cooling system, modify station operation, or take other mitigative measures as a result of this regulation.

On June 9, 1999, OCNGS applied for a renewal for its NJPDES surface-water permit. Until this renewal permit is finalized, the existing permit remains in effect. The draft permit, dated July 21, 2006, provided in the NJDEP fact sheet (NJDEP 2005) incorporated NJDEP's determination pursuant to Section 316(b) of the CWA and also proposes implementation of regulations for Section 316(b) of the CWA for existing facilities. The staff evaluated the aquatic impacts of OCNGS during the renewal period using the terms and limitations contained in the existing 1994 OCNGS NJPDES permit. The projected impacts associated with the terms and limitations contained in the draft permit are evaluated in Section 8 of this SEIS.

A single demonstration study was conducted for OCNGS between 1965 and 1977 to comply with Sections 316(a) and 316(b) of the CWA. Additional studies were conducted from 1978 to 1986. The demonstration study formed the basis for establishing the operational impacts of the once-through cooling-water system on important environmental resources. In 1987, the NJDEP contracted Versar, Inc., to assist in the technical review of the 316(a) and 316(b) demonstration study. Versar submitted the final technical review to the NJDEP in 1989 (Summers et al. 1989). Because the Versar review formed the basis of the NJDEP's decision to allow continued operation of the OCNGS under NJPDES rules, the NRC staff reviewed the information contained in both Summers et al. (1989) and EA (1986) to determine the impact of continued operations relative to the EPA Phase II rules. The NJDEP fact sheet (NJDEP 2005) was also reviewed to determine current guidance concerning NJPDES-related issues.

Estimates of microzooplankton (zooplankton smaller than 0.5 mm) entrainment by OCNGS were made in 1975 and 1976. Collections were conducted using a fixed net deployed in the discharge canal. The majority (71 percent) of the entrained organisms were copepods, and the total number of organisms (all taxa) entrained from September 1975 to August 1976 was estimated to be 6.9×10^{13} individuals (EA 1986). The numbers passing through the circulating-water system and dilution pumps were approximately equal because EA assumed that the densities of microzooplankton at both intake locations were equivalent, and that the total entrainment was regulated by flow rate. Summers et al. (1989) noted that collection efficiency was not stated in the EA report, but that most of the samples were apparently taken from one fixed discharge location. Summers et al. (1989) also noted that it was unlikely that the collection method employed at OCNGS resulted in 100 percent efficiency, and that the true collection efficiency could be as low as 13 percent because of the extrusion and loss of small fish larvae passing through the fixed nets, or avoidance of the nets entirely by more motile species. Thus, on the basis of the Summers et al. (1989) analysis, it is possible that the entrainment numbers presented by EA (1986) were underestimates of actual entrainment.

Macrozooplankton (zooplankton larger than 0.5 mm) entrainment studies were conducted from September 1975 to August 1981 (EA 1986). Collections were made using a fixed net deployed in the discharge canal. Mysid shrimp (family Mysidae) and *Crangon* spp. zoea made up the majority of macrozooplankton entrained during the study period. The total annual entrainment (September through August) ranged from 6.0×10^{10} to nearly 8.0×10^{10} organisms during the 6-year study. The exception to this was an annual entrainment of slightly less than 3.0×10^{10} organisms during the September 1978 through August 1979 sampling period (EA 1986). The uncertainties associated with macrozooplankton entrainment estimates are similar to those described above for microzooplankton.

Ichthyoplankton (larval fish) entrainment studies were conducted at OCNGS from September 1975 through August 1981. Larvae and eggs of bay anchovy (*Anchoa mitchilli*), and larvae of winter flounder (*Pseudopleuronectes americanus*), sand lance (*Ammodytes* spp.), and goby (unidentified species) represented the largest percentage of entrained organisms for all sampling years. Entrainment abundances varied considerably from year to year; the highest annual entrainment was observed in the 1975 to 1976 sampling year (3.2×10^{10} organisms), and the lowest entrainment was observed in 1979 to 1980 (1.5×10^{9} organisms) (EA 1986). The eggs of the bay anchovy were entrained from April through October, with the highest entrainment abundance from May to July. Larval and juvenile forms of the bay anchovy were entrained from May through December, with the highest entrainment occurring in July 1977. Goby larval entrainment was most common in the warmer months, occurring from May through October, with maximum entrainment abundances observed in July. Larvae of the sand lance and winter flounder were the most common organisms entrained from January to April, with the highest density for sand lance larval entrainment occurring in January 1976 (EA 1986).

Because the 316(a) and 316(b) demonstration report did not provide estimates of circulating-water system macrozooplankton entrainment losses for each year or estimates of dilution pump entrainment losses, Summers et al. (1989) estimated losses by assuming a 100 percent mortality rate for all entrained organisms (circulating-water system and dilution pumps). Entrainment loss is presented in Table 4-3; as the table indicates, the majority of the losses are

Table 4-3. Estimated Mean and Standard Error for Annual Entrainment Losses for Entrainable Organisms at OCNGS from 1975 to 1981

		Entrainment Losses (millions of organisms)				
		Circulation Pump		Dilution Pump		
Scientific Name	**Common Name**	**Mean**	**Standard Error**	**Mean**	**Standard Error**	**Total**
Anchoa mitchilli	Bay anchovy egg	5182	3299	5071	3106	10,253
Anchoa mitchilli	Bay anchovy larvae	6545	2543	6794	2607	13,339
Callinectes sapidus	Blue crab megalopae	80	22	68	18	148
Callinectes sapidus	Blue crab zoea	17	9	17	9	34
Crangon septemspinosa	Sand shrimp, juvenile and adult	3633	1227	4048	1157	7681
Crangon septemspinosa	Sand shrimp zoea	7225	1732	6383	1231	13,608
Mercenaria spp.	Clam larvae	63,530	NA[a]	48,800	NA	112,330
Neomysis integer	Opossum shrimp, juvenile and adult	101,302	21,119	108,587	13,531	209,889
Pseudopleuronectes americanus	Winter flounder larvae	2099	1588	2231	1685	4330

(a) NA = not available.
Source: Summers et al. 1989

associated with larvae, juvenile, and adult opossum shrimp (*Neomysis integer*), and larvae of the hard clam (*Mercenaria mercenaria*). The smallest losses are associated with blue crab (*Callinectes sapidus*) zoea (34 million lost) and larvae (148 million lost).

To evaluate the impact of these entrainment losses, the NRC staff evaluated three assessments concerning the potential impact of entrainment at OCNGS on ecologically, recreationally, or commercially important species: (1) the conclusions of the 316(a) and (b) demonstration presented in EA (1986), (2) the conclusions based on Versar's review of the EA study (Summers et al. 1989), and (3) the conclusions and recommendations provided in the NJDEP fact sheet (NJDEP 2005) regarding the renewal of the OCNGS NJPDES permit. The NRC staff also compared its assessment of impact with the conclusions stated in Kennish (2001), because that author had reviewed most of the information available to the staff. A summary of the conclusions associated with entrainment impact follows.

Based on the findings of the 316(a) and 316(b) demonstration, the overall conclusion regarding the environmental impacts of entrainment was that ". . . although some losses of entrained macrozooplankton have occurred, no obvious changes in the community due to the operation of OCNGS was [were] suggested" and ". . . it does not appear that the OCNGS operation has either affected the structure of the sand shrimp (*Crangon septemspinosa*) or blue crab population or reduced the standing crop of juvenile and adult blue crab in the bay" (EA 1986).

For entrainment impacts on fish, the report concludes, "Similarly, the fish community in the bay has not experienced any variation in species composition or abundance of populations that reproduce in the bay that were not also noted for other southern New Jersey and mid-Atlantic estuaries, and therefore, these reductions in Barnegat Bay were attributed to environmental factors that affect those populations through the mid-Atlantic area rather than OCNGS entrainment losses." The report concluded that "although little data exist on zoo- and ichthyoplankton communities in the bay prior to 1969, it does not appear that entrainment of these forms at the OCNGS has affected either the invertebrate populations in the bay or the various component populations to a point where changes were detected."

Based on their review of EA (1986), Summers et al. (1989) concluded that the "continued operation of the Oyster Creek NGS at the estimated levels of losses to representative important species populations, without modification to the intake structures and/or operating practices, does not threaten the protection and propagation of balanced, indigenous populations." It is believed that this statement was made with regard to entrainment, impingement, and thermal impacts, but it is not specifically stated as such in the Summers et al. (1989) report. It should be noted that the Summers et al. (1989) entrainment estimates were adjusted upward to account for sampling-gear inefficiency, and that entrainment mortality through both the circulating-water system and dilution pumps was assumed to be 100 percent to provide an environmentally conservative assessment. This was a particularly conservative assessment because the organisms entrained through the dilution pumps are not subjected to the same hydrodynamic and thermal stresses present in the circulating-water system.

This assessment (Summers et al. 1989) was based on population and ecosystem modeling (equivalent adult model, production foregone model, and spawning/nursery area of consequence model) to determine the environmental consequences of impingement and entrainment. The results of these models evaluate the combined losses associated with both impingement and entrainment. Using conservative assumptions to estimate OCNGS impingement and entrainment losses, data available on population sizes, and survival rates and trophic relationships, Summers et al. (1989) concluded that population losses were rapidly compensated for by reproduction (e.g., sand shrimp), were a small fraction of the bay population (e.g., blue crab and winter flounder), or had little effect on higher trophic levels (e.g., bay anchovy and opossum shrimp).

Although NJDEP (2005) acknowledged the Summers et al. (1989) conclusion that OCNGS did not appear to produce “unacceptable, substantial long-term population and ecosystem level impacts,” the agency stated that it is not necessary to prove that an impact on a population is occurring to require the applicant to meet Section 316(b) performance standards. The NJDEP goes on to state that “this rationale is consistent with the Phase II regulations which specify compliance alternatives, including national performance standards, and do not define adverse environmental impact.” The entrainment performance standard in the EPA’s Phase II regulations requires that entrainment mortality for all life stages of fish and shellfish be reduced by 60 to 90 percent from the calculated baseline, although there is no clear definition of how the baseline is to be calculated.

In September 2005, after discussions and approval by NJDEP, the applicant began an intake sampling program for entrainment and impingement as part of an effort to demonstrate compliance with the new regulations. Based on the results of this and other studies, the State of New Jersey may require additional mitigation measures, such as the installation of cooling towers, to reduce entrainment.

There is no evidence to suggest that past, current, or future entrainment of eggs, larvae, or juvenile forms of these species would destabilize or noticeably alter any important attribute of the resource. This conclusion was also reached by Kennish (2001), who stated that “despite the large numbers of eggs, larvae, and small life forms of Barnegat Bay organisms lost via in-plant passage at the OCNGS, these losses have not resulted in detectable impacts on biotic communities in Barnegat Bay. Effects of operation of the OCNGS on aquatic communities appear to be restricted to the discharge canal and Oyster Creek.” On the basis of a review of the available information, it is the NRC staff’s conclusion that the potential impacts of entrainment of fish and shellfish through the existing once-through cooling system during the renewal period would be SMALL. Regardless of the determination of impact, compliance with EPA's Phase II regulations may require modifications to the facility.

During the preparation of this SEIS, the NRC staff considered mitigation measures to reduce entrainment losses at OCNGS during a license renewal period. The staff evaluated two alternatives to the current station cooling system. That analysis is presented in section 8.1 of this SEIS.

4.1.2 Impingement of Fish and Shellfish

For power plants with once-through cooling-systems, the impingement of fish and shellfish in early life stages by nuclear power plant cooling systems is considered a Category 2 issue that requires plant-specific assessment for license renewal. The NRC staff independently reviewed the AmerGen ER (AmerGen 2005a), visited the site, and reviewed the applicant's current NJPDES permit and the NJDEP fact sheet describing the OCNGS draft permit and the permit renewal process (NJDEP 2005). The NRC staff also reviewed relevant scientific articles and compilations associated with the study area, documents and technical reports from NJDEP and its contractor (Versar, Inc.), the NMFS, the U.S. Geological Survey, and the BBNEP. The NRC staff also spoke to scientists at Rutgers University who have conducted research in Barnegat Bay.

Section 316(b) of the CWA requires that the location, design, construction, and capacity of the cooling-water intake structures reflect the best technology available for minimizing adverse environmental impacts. Impingement of fish and shellfish into the cooling-water system is a potential adverse environmental impact.

On July 9, 2004, the EPA published a final rule in the *Federal Register* (69 FR 41575) addressing cooling-water intake structures with flow levels exceeding a minimum threshold value of 50 million gpd at existing power plants. The rule is Phase II in the EPA's development of 316(b) regulations that establish national requirements applicable to the location, design, construction, and capacity of cooling-water intake structures at existing facilities that exceed the threshold value for water withdrawals. The national requirements, which are implemented through NPDES permits, are designed to minimize the adverse environmental impacts, including impingement losses, associated with the continued use of the intake systems. The new performance standards are designed to significantly reduce impingement losses resulting from plant operation. Licensees are required to demonstrate compliance with the Phase II performance standards at the time of renewal of their NPDES permit. As part of the NPDES renewal, licensees may be required to alter the intake structure, redesign the cooling system, modify station operation, or take other mitigative measures as a result of this regulation.

On June 9, 1999, OCNGS applied for a renewal for its NJPDES surface-water permit. Until this renewal permit is finalized, the existing permit remains in effect. The draft permit, dated July 21, 2006, provided in the NJDEP fact sheet (NJDEP 2005) incorporated NJDEP's determination pursuant to Section 316(b) of the CWA and also proposes implementation of regulations for Section 316(b) of the CWA for existing facilities. The staff evaluated the aquatic impacts of OCNGS during the renewal period using the terms and limitations contained in the existing 1994 OCNGS NJPDES permit. The projected impacts associated with the terms and limitations contained in the draft permit are evaluated in Section 8 of this SEIS.

Impingement mortality studies were conducted between 1975 and 1978, and in 1985 (EA 1986). During 1975 and 1978, immediate and latent mortality estimates were made as a part of impingement sampling. Immediate mortality was determined by transferring impinged organisms collected from the intake screens to insulated coolers filled with ambient water and observing the number alive, dead, and damaged after 5 to 10 min. Latent mortality was determined by holding impinged organisms recovered from the screens in ambient and heated water for 96 hours, then determining the number alive and dead (Summers et al. 1989). The heated water procedure was intended to simulate the conditions impinged organisms would encounter after they were released into the discharge canal. In 1985, immediate mortality was determined as a part of the latent mortality procedure and the cooler method was not used. A detailed explanation of the experimental procedures used for the latent mortality test was not described in the demonstration study (EA 1986), but Summers et al. (1989) noted in its review of EA (1986) that it appears that the timing of the impingement mortality tests encompassed all seasons and most of the species of interest.

Table 4-4 presents the summary information for immediate and latent mortality for both conventional and Ristroph screens, because the study years reflected the use of both technologies. The experimental design did not evaluate all species under each scenario. Bay anchovies and Atlantic menhaden (*Brevoortia tyrannus*) appeared to exhibit the highest overall impingement mortality. Mortality for the bay anchovy ranged from 81 to 99 percent for both screen types and mortality estimators; immediate and latent mortalities for Atlantic menhaden were 73 and 86 percent, respectively, for conventional screens only. Mortality associated with Ristroph screens was not evaluated for Atlantic menhaden. Winter flounder, sand shrimp, and blue crab exhibited lower impingement mortality. Winter flounder impingement mortality ranged from 2 to 23 percent under all screen and mortality scenarios. Sand shrimp impingement mortality ranged from 5 to 50 percent under all screen and mortality scenarios, with the lowest mortality.

Table 4-4. Total Mortality Rate Estimates (Percent) Determined from Immediate and Latent Mortality Studies from 1975 to 1978 and 1985

		Percent of Organisms Killed			
		Conventional Screens		Ristroph Screens	
Scientific Name	Common Name	Ambient (immediate)	Heated (latent)	Ambient (immediate)	Heated (latent)
Anchoa mitchilli	Bay anchovy	96	99	81	96
Brevoortia tyrannus	Atlantic menhaden	73	86	NA[(a)]	NA
Callinectes sapidus	Blue crab	12	13	NA	NA
Crangon septemspinosa	Sand shrimp	14	29	5	50
Menidia menidia	Atlantic silverside	41	48	20	33
Pseudopleuronectes americanus	Winter flounder	4	4	7	23

(a) NA = data not available.
Source: Summers et al. 1989

observed on Ristroph screens followed by immediate assessment of survival (Table 4-4). Blue crab impingement mortality was only conducted for conventional screen technology, and was 12 and 13 percent for immediate and latent mortality estimation procedures, respectively.

Estimates of annual impingement losses were made at OCNGS from September 1975 to December 1985. According to Summers et al. (1989), the frequency of sampling and time of day when samples were collected changed appreciably over the 10-year period. For 9 of 10 years, samples were collected in an enlarged section of the sluiceway associated with the fish-return system by using a sampler with a 10.7-mm screen mesh. During the last year of the study, the fish-return system was modified so that the screen wash could be diverted into a holding pool. A sampler with a 6.4-mm screen mesh was used to collect previously impinged organisms (Summers et al. 1989). On the basis of the differences between the mesh size of the traveling screens (9.5 mm) and the mesh sizes of the sampling devices used (10.7 mm for 9 years, 6.4 mm for 1 year), it is likely that impingement was underestimated for the first 9 years of the study and overestimated for the last year of the study.

Based on the Summers et al. (1989) review of the demonstration study (EA 1986), it appears that there were significant uncertainties associated with the estimated number of impinged organisms, the impingement survivability for all impinged species, and the overall efficiency of the equipment used to capture the impinged organisms. The main findings of the Summers et al. (1989) review are as follows:

- The mesh size of the impingement sampling equipment (10.7 mm for nine study years; 6.4 mm for one study year) did not match the mesh size used in the conventional or Ristroph screens (9.5 mm). This suggests that actual impingement abundances could be either under- or overestimated.

- The demonstration study assumed 100 percent intake screen collection efficiency, even though no collection efficiency studies were conducted on the vertical traveling screens, and the collection efficiency in the study conducted on the Ristroph screens in 1985 ranged from 53 to 90 percent in May and November testing months, respectively.

- The Ristroph screen collection efficiency study conducted in 1985 evaluated only one species, Atlantic silverside (*Menidia menidia*), and the design involved releasing preserved, fin-clipped specimens in front of the intake screens and recollection in screen wash samples for 30 min.

Summers et al. (1989) estimates for average annual impingement loss based on the survivability in heated water and a 53-percent screen collection efficiency (worst case-scenario) are presented in Table 4-5. These estimates are for the current Ristroph screen configuration at OCNGS and have omitted the 1982-to-1983 data because an extended plant outage occurred at that time. The largest average annual impingement losses are associated with sand shrimp, with an average annual loss of 8,023,555 individuals. The large standard error associated with this estimate probably reflects the high degree of variability in impingement data, seasonal trends, and/or the influence of other environmental factors. The average annual impingement losses of bay anchovy and blue crab each exceed 250,000 individuals, and the mean annual impingement loss of Atlantic silversides is estimated to be 122,769 individuals. Average annual impingement losses of winter flounder and Atlantic menhaden are approximately equal and were slightly less than 14,000 individuals each.

The NRC staff evaluated three assessments concerning the potential impact of impingement at OCNGS for ecologically, recreationally, or commercially important fish and shellfish species: (1) the conclusions of the 316(a) and 316(b) demonstration presented in EA (1986), (2) the conclusions based on Versar's review of the EA study (Summers et al. 1989), and (3) the conclusions and recommendations provided in the NJDEP fact sheet (NJDEP 2005) regarding the renewal of the OCNGS NJPDES permit. The NRC staff also compared its assessment of impacts with the conclusions stated in Kennish (2001), because the author had reviewed most of the information available to the NRC staff. A summary of the conclusions associated with impingement impacts follows.

On the basis of the results of impingement monitoring conducted during the demonstration study, the species experiencing the largest losses due to impingement are the bay anchovy, sand shrimp, and blue crab (EA 1986). In assessing impingement impacts on these species,

Table 4-5. Average Annual Impingement Loss at OCNGS

Scientific Name	Common Name	Number of Organisms Impinged[(a)]	
		Mean	Standard Error
Anchoa mitchilli	Bay anchovy	253,567	62,490
Brevoortia tyrannus	Atlantic menhaden	13,964	3472
Callinectes sapidus	Blue crab	276,361	112,604
Crangon septemspinosa	Sand shrimp	8,023,556	4,292,019
Menidia menidia	Atlantic silverside	122,769	47,203
Pseudopleuronectes americanus	Winter flounder	13,378	3952

(a) Data from 1980 to 1985; 1982 and 1983 data not available. Based on mortality rate for heated water and 53 percent screen collection efficiency.
Source: Summers et al. 1989

EA (1986) compared the estimated number impinged with population estimates for Barnegat Bay that were developed during the demonstration study. For the bay anchovy, EA concluded that the impingement losses of bay anchovy at OCNGS represented between 2 and 10 percent of the estimated population of Barnegat Bay. EA also noted that population estimates associated with trawl studies generally result in high variability, given the distribution of the fish in the water column, and suggested that the actual populations of bay anchovy are much higher than the trawl-derived estimates. EA (1986) concluded that “no evidence exists that the population of this species in Barnegat Bay has decreased substantially because of the operation of the OCNGS.” Similar conclusions were reached for impingement impacts on sand shrimp and blue crab. EA estimated that sand shrimp losses associated with impingement represented approximately 1.5 percent of the estimated population in Barnegat Bay (Good Luck Point to Gulf Point), and that operation of the plant did not harm the community that existed at that time. Blue crab losses to impingement at OCNGS in July 1976 represented approximately 3.5 percent of the estimated population in Barnegat Bay at that time, and losses in August 1977 represented less than 1 percent of the estimated bay population. EA concluded that these losses did not harm the blue crab fishery because commercial landings had not decreased since OCNGS began operation, and the population structure of the species during the study period was similar to Great Bay, an estuary south of Barnegat Bay that is not influenced by OCNGS.

As described above, Summers et al. (1989) identified a number of uncertainties associated with the sampling and data analyses that EA conducted during the demonstration study. For impingement, one of the most significant findings was that the screen mesh size (10.7 mm or 6.4 mm) of sampling equipment used to collect previously impinged organisms did not match the screen mesh size (9.5 mm) of the traveling screens used at the OCNGS circulating-water intake. During the 10-year study, the sampling-gear screen mesh size was larger than the traveling screen mesh for 9 study years and smaller for 1 study year. Summers et al. (1989) concluded that the impingement estimates were probably underestimated for nine years and overestimated for the last study year. Despite these concerns, Summers et al. (1989) concluded that "continued operation of the Oyster Creek NGS at the estimated levels of losses to representative important species populations, without modification to intake structures and/or operating practices, does not threaten the protection and propagation of balanced, indigenous populations."

This assessment (Summers et al. 1989) was based on population and ecosystem modeling (equivalent adult model, production foregone model, and spawning/nursery area of consequence model) to determine the environmental consequences of impingement and entrainment. The results of these models evaluate the combined losses associated with both impingement and entrainment. Using conservative assumptions to estimate OCNGS impingement and entrainment losses, data available on population sizes, and survival rates and trophic relationships, Summers et al. (1989) concluded that population losses were rapidly compensated for by reproduction (e.g., sand shrimp), were a small fraction of the bay population (e.g., blue crab and winter flounder), or had little effect on higher trophic levels (e.g., bay anchovy and opossum shrimp).

Although NJDEP (2005) acknowledged the Summers et al. (1989) conclusion that OCNGS did not appear to produce "unacceptable, substantial long-term population and ecosystem level impacts," the agency stated that it is not necessary to prove that an impact on a population is occurring to require the applicant to meet Section 316(b) performance standards. The NJDEP goes on to state that "this rationale is consistent with the Phase II regulations which specify compliance alternatives, including national performance standards, and do not define adverse environmental impact." The impingement performance standard in the EPA's Phase II regulations requires that impingement mortality for all life stages of fish and shellfish be reduced by 80 to 95 percent from the calculated baseline, though there is no clear definition of how the baseline is to be calculated.

There is no evidence to suggest that past, current, or future impingement of these species would destabilize or noticeably alter any important attribute of the resource. This conclusion was also reached by Kennish (2001), who stated, after reviewing 316(b) demonstration study data from 1975 to 1977 and 1984 to 1985, that "population surveys of fishes and macroinvertebrates indicate that the standing crop lost through impingement was <10 percent for species in central Barnegat Bay. No evidence exists that losses of organisms through impingement on the intake screens have had a discernible effect on invertebrate and fish communities in the bay." On the basis of a review of the available information, the NRC staff concludes that the potential impacts of impingement of fish and shellfish as a result of operation of the existing once-through cooling system during the renewal period would be SMALL.

Regardless of the determination of impact, compliance with the EPA's Phase II regulations may require modifications to the facility.

During the preparation of this SEIS, the NRC staff considered mitigation measures to reduce impingement losses at OCNGS during a license renewal period. The staff evaluated two alternatives to the current station cooling system. That analysis is presented in section 8.1 of this SEIS.

4.1.3 Heat Shock

For plants with once-through cooling systems, the effects of heat shock are listed as a Category 2 issue and require plant-specific evaluation for license renewal. Impacts on fish and shellfish resources resulting from heat shock are a Category 2 issue because of continuing concerns about thermal-discharge effects and the possible need to modify thermal discharges in the future in response to changing environmental conditions (NRC 1996).

Information to be considered includes (1) the type of cooling system and (2) evidence of a CWA Section 316(a) variance or equivalent State documentation. To perform this evaluation, the NRC staff reviewed the AmerGen ER (2005a); visited the OCNGS site; reviewed the facility's 316(a) demonstration study (EA 1986); reviewed Versar's evaluation of the 316(a) demonstration (Summers et al. 1989); reviewed the applicant's existing NJPDES Permit No. NJ0005550 for OCNGS; and reviewed the proposed NJDEP draft permit and accompanying NJDEP fact sheet (NJDEP 2005). The fact sheet describes the principal facts and the significant legal and policy issues considered by NJDEP during the preparation of the draft permit that will govern activities at OCNGS until the permit expires on April 30, 2009 (the same date the current OL for OCNGS expires). Although 316(a) demonstration data presented in EA (1986) were reviewed, the staff's emphasis was placed on Versar's and NJDEP's analyses and conclusions because they directly relate to NJPDES permit issues.

During the 316(a) demonstration study conducted between 1969 and 1976, four types of analyses were conducted to determine the thermal impacts associated with the OCNGS cooling-water discharge: (1) dye studies to define the circulation patterns in Barnegat Bay and to estimate the potential dimensions and characteristics of the thermal plume; (2) thermal plume studies that included the use of towed thermistors and infrared thermographic overflights with a ground-truth component; (3) recirculation studies that involved the measurement of water temperature at the mouth of the Forked River and consideration of meteorological and plant-related activities to determine the extent of heated water circulation back into the OCNGS system after its release into Barnegat Bay; and (4) hydrothermal modeling. All of these studies were required to fully understand the dynamics of the thermal plume and to determine whether OCNGS operations complied with NJDEP permit-related discharge requirements.

In the NJDEP fact sheet (NJDEP 2005), the following thermal surface-water quality standards applicable to Barnegat Bay, Forked River, and Oyster Creek were identified:

- Ambient water temperatures in the receiving waters shall not be raised by more than 2.2 °C (4 °F) from June through August, nor more than 0.8 °C (1.5 °F) from June through August, nor cause temperature to exceed 29.4 °C (85 °F), except in designated heat dissipation areas.

- Heat dissipation in streams (including saline estuarine waters) shall not exceed one-quarter of the cross section and/or volume of the water body at any time; nor more than two-thirds of the surface from shore to shore at any time.

The fact sheet concludes that the heat dissipation areas ". . . may be exceeded by special permission, or on a case-by-case basis, when a discharger can demonstrate that a larger heat dissipation area meets the tests for a waiver under Section 316 of the Federal Clean Water Act."

The results of the dye studies conducted as part of the 316(a) demonstration showed that circulation in Barnegat Bay is primarily driven by wind, and in five of six surveys, there was a potential for recirculation of the discharge water from Oyster Creek back to the mouth of the Forked River.

In their review of the 316(a) thermal plume demonstration studies, Summers et al. (1989) identified several study design concerns (primarily related to the estimation of ambient temperature) that influenced the results presented in EA (1986). The primary concern was the placement of an ambient water temperature station at the mouth of the Forked River. Summers et al. (1989) believed that a temperature monitoring station at this location would potentially be influenced by the heated water circulation patterns identified in the dye studies and would result in a "potentially serious" underestimation of the 4 °F and 1.5 °F thermal plumes. They concluded that the 316(a) demonstration did not correctly assess the true ambient temperature of Barnegat Bay, and thus, the use of water temperature monitoring cannot identify the true extent of the 4 °F and 1.5 °F plumes (Summers et al. 1989). The Summers et al. (1989) review suggested that of the two methods used (towed thermistors and low-altitude overflights), the overflight procedure represented the best technology for measuring temperature in Barnegat Bay. The results of the overflights demonstrated that the thermal plume extent and width often violated State surface-water quality standards, as described in the NJDEP (2005) fact sheet.

The 316(a) demonstration study (EA 1986) estimated the recirculation of heated water by monitoring the Forked River intake for 23 days and comparing the intake temperature time series with a time series of power production from OCNGS; air temperature in Newark, New Jersey; and the southerly wind component. The conclusion in the demonstration study was that the potential for recirculation was small. Summers et al. (1989) disagreed with this assessment, pointing out that the required data to fully understand the complex interactions among water temperature, air temperature, and other factors were not available, and that the results of the EA (1986) analyses contradict the dye study results.

Summers et al. (1989) also were critical of the hydrodynamic modeling conducted to support the 316(a) demonstration and concluded that the two-dimensional steady-state mass and heat balance model used ". . . was a poor reflection of the dynamic conditions characterizing Barnegat Bay" and that ". . . the modeling regime chosen does not represent the best available methods for evaluating plume characteristics."

The NRC staff's conclusion is that the analysis conducted by Summers et al. (1989) provided the most realistic and complete description of thermal impacts associated with OCNGS and was taken into account during the NJDEP's development of the draft NJPDES permit.

Interruption of the flow of heated water from the plant or failure of the dilution pump system resulted in a number of fish kills since OCNGS began operating in 1969. Fish kills are documented in the OCNGS Annual Environmental Monitoring Reports submitted to the NRC. Fish kills associated with thermal fluctuations from 1972 to 1982 are summarized in Kennish (2001). A review of this information shows that fish kills resulting in the death of more than 1000 fish occurred five times between January 29, 1972, and January 15, 1974. In all cases, thermal shock was the probable cause of death. From 1974 to 1982, the number and magnitude of fish kills was greatly reduced and appears to reflect procedural changes at OCNGS and upgrades to critical systems used to regulate thermal discharges. Fish kill information for 1999 to 2004 documented in OCNGS Annual Environmental Monitoring Reports (GPU Nuclear, Inc. 2000; AmerGen 2001a, 2002a, 2003a, 2004a, 2005b) shows that only one event has been documented in this time period. On September 23, 2002, 5876 fish were killed, of which 75 percent were striped bass, Atlantic menhaden (*Brevoortia tyrannus*), and white perch (*Morone americana*). Mortality was attributed to heat shock because of accidental shutdown of the dilution pumps during a routine electrical maintenance procedure. During that event, the water temperature in the discharge canal at the U.S. Highway 9 bridge rose from approximately 91 to 101°F within 3 hours of pump shutdown; the temperature at this location remained at 100 °F for several hours until the dilution pump operation was restored (AmerGen 2003a). The 2002 event was considered a permit violation, and the required notifications were made to the NRC and NJDEP. Following this incident, an Administrative Order and Notice of Civil Administrative Penalty Assessment were issued to AmerGen citing the permit violation and the natural resource damage resulting from this violation (AmerGen 2003a).

On the basis of their review of the 316(a) demonstration study presented in EA (1986), Summers et al. (1989) concluded that OCNGS did not comply with NJDEP's Surface Water Quality Standards for thermal discharges, but noted that the discharge effects were localized and small and did not result in adverse impacts on Barnegat Bay. In the 2005 fact sheet accompanying the draft permit, the NJDEP noted that in the June 30, 1994, draft renewal permit, the department had concluded that the existing thermal limitations and operating requirements met the 316(a) criteria based on the results of the OCNGS demonstration study (NJDEP 2005). However, the following conditions required in the 1994 permit also apply during the renewal period:

- OCNGS is required to continuously monitor the temperature of Oyster Creek at the U.S. Highway 9 bridge. A maximum water temperature of 97 °F at a level of 4 ft below the water surface is permitted at this location.

- OCNGS is allowed to increase its heat load, effluent temperature, and delta-T (change in temperature) limitations at outfall DSN001A (Oyster Creek discharge canal) during a Maximum Emergency Generation Event following a procedure described in NJDEP's fact sheet (2005).

On the basis of a review of the available information, including that provided by the applicant, the site visit, the State of New Jersey and its subcontractor (Versar, Inc.), and the 316(a) demonstration study presented in EA (1986), the NRC staff concludes that potential impacts on fish and shellfish due to heat shock during the renewal term would be SMALL. Although there have been significant fish kills since OCNGS began operation, the frequency and magnitude of the events have decreased. This is attributed to upgrades to critical systems used to regulate thermal discharges and additional monitoring requirements imposed by NJDEP following fish kill events.

Because the potential impacts to fish and shellfish due to heat shock during the renewal term were determined to be SMALL, additional mitigation was not considered. The staff evaluated two alternatives to the current station cooling system design. An analysis of the two alternatives is presented in section 8.1 of this SEIS.

4.2 Transmission Lines

The Final Environmental Statement (FES) for OCNGS (AEC 1974) describes one transmission line that connects OCNGS with the transmission system. That line, the 230-kV OCNGS-to-Manitou line is 11.1 mi long and runs north of the OCNGS substation and generally parallel to the Garden State Parkway. The northern phase of a second 230-kilovolt (kV) transmission line was recently completed from the OCNGS substation to the Cedar substation in Ocean County. The line is owned by Atlantic City Electric (formerly Conectiv), a mid-Atlantic electric distribution company. The line is not considered within the scope of license renewal because it was not constructed for the specific purpose of connecting the station to the grid at the time of initial station licensing.

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to the within-scope transmission line from OCNGS are listed in Table 4-6. AmerGen stated in its ER (AmerGen 2005a) that it is not aware of any new and significant information associated with the renewal of the OCNGS OL. The NRC staff has not identified any new and significant

Table 4-6. Category 1 Issues Applicable to the OCNGS Transmission Line During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
TERRESTRIAL RESOURCES	
Power line right-of-way management (cutting and herbicide application)	4.5.6.1
Bird collisions with power lines	4.5.6.2
Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, and livestock)	4.5.6.3
Floodplains and wetlands on power line right-of-way	4.5.7
AIR QUALITY	
Air quality effects of transmission lines	4.5.2
LAND USE	
Onsite land use	4.5.3
Power line right-of-way	4.5.3

information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of those issues, the NRC staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the NRC staff's review and GEIS conclusions, as codified in 10 CFR Part 51, Table B-1, for each of these issues follows:

- <u>Power line right-of-way management (cutting and herbicide application)</u>. Based on information in the GEIS, the Commission found that

  > The impacts of right-of-way maintenance on wildlife are expected to be of small significance at all sites.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, consultation with the U.S. Fish and Wildlife Service (FWS) and the NJDEP Endangered and Nongame Species Program, or its evaluation of other information. Therefore, the NRC staff concludes that there would be no impacts of power line right-of-way maintenance during the renewal term beyond those discussed in the GEIS.

- <u>Bird collisions with power lines</u>. Based on information in the GEIS, the Commission found that

  > Impacts are expected to be of small significance at all sites.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, consultation with the FWS and the NJDEP Endangered and Nongame Species Program, or the evaluation of other information. Therefore, the NRC staff concludes that there would be no impacts of bird collisions with power lines during the renewal term beyond those discussed in the GEIS.

- <u>Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, and livestock)</u>. Based on information in the GEIS, the Commission found that

  > No significant impacts of electromagnetic fields on terrestrial flora and fauna have been identified. Such effects are not expected to be a problem during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other information. Therefore, the NRC staff concludes that there would be no impacts of electromagnetic fields on flora and fauna during the renewal term beyond those discussed in the GEIS.

- <u>Floodplains and wetlands on power line rights-of-way</u>. Based on information in the GEIS, the Commission found that

  > Periodic vegetation control is necessary in forested wetlands underneath power lines and can be achieved with minimal damage to the wetland. No significant impact is expected at any nuclear power plant during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, consultation with the FWS and the NJDEP Endangered and Nongame Species Program, or the evaluation of other information. Therefore, the NRC staff concludes that there would be no impacts of power line rights-of-way on floodplains and wetlands during the renewal term beyond those discussed in the GEIS.

- Air quality effects of transmission lines. Based on the information in the GEIS, the Commission found that

  > Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other information. Therefore, the NRC staff concludes that there would be no air quality impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

- Onsite land use. Based on the information in the GEIS, the Commission found that

  > Projected onsite land use changes required during . . . the renewal period would be a small fraction of any nuclear power plant site and would involve land that is controlled by the applicant.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other information. Therefore, the NRC staff concludes that there would be no onsite land use impacts during the renewal term beyond those discussed in the GEIS.

- Power line rights-of-way. Based on information in the GEIS, the Commission found that

  > Ongoing use of power line rights-of-way would continue with no change in restrictions. The effects of these restrictions are of small significance.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other information. Therefore, the NRC staff concludes that there would be no impacts of power line rights-of-way on land use during the renewal term beyond those discussed in the GEIS.

There is one Category 2 issue related to the transmission line, and another issue related to the transmission line is evaluated here. These issues are listed in Table 4-7 and are discussed in Sections 4.2.1 and 4.2.2.

4.2.1 Electromagnetic Fields – Acute Effects

Based on the GEIS, the Commission found that electric shock resulting from direct access to energized conductors or from induced charges in metallic structures has not been found to be a problem at most operating plants and generally is not expected to be a problem during the

Table 4-7. Category 2 and Uncategorized Issues Applicable to the OCNGS Transmission Line During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR Part 51.53(c)(3)(ii) Subparagraph	SEIS Section
HUMAN HEALTH			
Electromagnetic fields, acute effects (electric shock)	4.5.4.1	H	4.2.1
Electromagnetic fields, chronic effects	4.5.4.2	NA[a]	4.2.2
(a) NA = not addressed.			

license renewal term. However, site-specific review is required to determine the significance of the electric shock potential along the portions of the transmission lines that are within the scope of this SEIS.

In the GEIS (NRC 1996), the NRC staff found that without a review of the conformance of each nuclear plant transmission line with National Electrical Safety Code (NESC) criteria (IEEE 2002), it was not possible to determine the significance of the electric shock potential. Evaluation of individual plant transmission lines is necessary because the issue of electric shock safety was not addressed in the licensing process for some plants. For other plants, land use in the vicinity of transmission lines may have changed, or power distribution companies may have chosen to upgrade line voltage. To comply with 10 CFR 51.53(c)(3)(ii)(H), the applicant must provide an assessment of the impact of the proposed action on the potential shock hazard from the transmission lines if the transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the NESC for preventing electric shock from induced currents.

OCNGS is connected to the grid by two transmission lines, the OCNGS-to-Manitou line and the OCNGS-to-Cedar line. Only the OCNGS-to-Manitou line is within the scope of the license renewal review and is discussed below. AmerGen performed field measurements to support its assertion that the OCNGS-to-Manitou 230-kV transmission line is in compliance with the NESC 5-milliampere (mA), electric-field-induced current limit. Field measurements demonstrate that the electric-field-induced current from this transmission line is below the NESC recommendations for preventing electric shock from induced currents (AmerGen 2005a).

Additionally, AmerGen calculated the electric field strength and induced current at locations where the potential for induced shock would be the greatest. These calculations determined that there are no locations under the transmission line that have the capacity to induce more than a 5-mA current inside a vehicle parked beneath the line.

The NRC staff has reviewed the available information, including that obtained from the applicant, the site visit, the scoping process, and other public sources. Using this information, the NRC staff evaluated the potential impacts for electric shock resulting from operation of OCNGS and its associated transmission line. It is the NRC staff's conclusion that the potential impacts from electric shock during the renewal term would be SMALL, and that no additional mitigation measures are warranted.

4.2.2 Electromagnetic Fields – Chronic Effects

In the GEIS, the chronic effects of 60-Hz electromagnetic fields from power lines were not designated as Category 1 or 2, and will not be until a scientific consensus is reached on the health implications of these fields.

The potential for chronic effects from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy (DOE). A NIEHS report (NIEHS 1999) contains the following conclusion:

> The NIEHS concludes that ELF-EMF [extremely low frequency-electromagnetic field] exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

This statement is not sufficient to cause the NRC staff to change its position with respect to the chronic effects of electromagnetic fields. Footnote 4 to Table B-1 states: "If in the future, the Commission finds that, contrary to current indications, a consensus has been reached by appropriate Federal health agencies that there are adverse health effects from electromagnetic fields, the Commission will require applicants to submit plant-specific reviews of those health effects as part of their license renewal applications. Until such time, applicants for license renewal are not required to submit information on this issue." The NRC staff considers the GEIS finding of "Uncertain" still appropriate and will continue to follow developments on this issue.

4.3 Radiological Impacts of Normal Operations

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to OCNGS in regard to radiological impacts are listed in Table 4-8. AmerGen stated in its ER (AmerGen 2005a) that it is not aware of any new and significant information associated with the renewal of the OCNGS OL. The NRC staff has not identified any new and significant information during its independent review of the ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts related to these issues beyond those discussed in the GEIS. For these issues, the NRC staff concluded in the GEIS that the impacts would be SMALL, and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-8. Category 1 Issues Applicable to Radiological Impacts of Normal Operations During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
HUMAN HEALTH	
Radiation exposures to public (license renewal term)	4.6.2
Occupational radiation exposures (license renewal term)	4.6.3

A brief description of the NRC staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows:

- Radiation exposures to the public (license renewal term). Based on information in the GEIS, the Commission found that

  > Radiation doses to the public will continue at current levels associated with normal operations.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of radiation exposures to the public during the renewal term beyond those discussed in the GEIS.

- Occupational radiation exposures (license renewal term). Based on information in the GEIS, the Commission found that

> Projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages, and would be well below regulatory limits.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts of occupational radiation exposures during the renewal term beyond those discussed in the GEIS.

There are no Category 2 issues related to radiological impacts of routine operations.

4.4 Socioeconomic Impacts of Plant Operations During the License Renewal Period

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to socioeconomic impacts during the renewal term are listed in Table 4-9. AmerGen stated in its ER (AmerGen 2005a) that it is not aware of any new and significant information associated with the renewal of the OCNGS OL. The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS (NRC 1996). For these issues, the NRC staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-9. Category 1 Issues Applicable to Socioeconomics During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
SOCIOECONOMICS	
Public services: public safety, social services, and tourism and recreation	4.7.3; 4.7.3.3; 4.7.3.4; 4.7.3.6
Public services: education (license renewal term)	4.7.3.1
Aesthetic impacts (license renewal term)	4.7.6
Aesthetic impacts of transmission lines (license renewal term)	4.5.8

A brief description of the NRC staff's review and the GEIS conclusions, as codified in Table B-1, for each of these issues follows:

- Public services: public safety, social services, and tourism and recreation. Based on information in the GEIS, the Commission found that

  > Impacts on public safety, social services, and tourism and recreation are expected to be of small significance at all sites.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts on public safety, social services, and tourism and recreation during the renewal term beyond those discussed in the GEIS.

- Public services: education (license renewal term). Based on information in the GEIS, the Commission found that

  > Only impacts of small significance are expected.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts on education during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts (license renewal term). Based on information in the GEIS, the Commission found that

  > No significant impacts are expected during the license renewal term.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no aesthetic impacts during the renewal term beyond those discussed in the GEIS.

- Aesthetic impacts of transmission lines (license renewal term). Based on information in the GEIS, the Commission found that

  > No significant impacts are expected during the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no aesthetic impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

Table 4-10 lists the Category 2 socioeconomic issues, which require plant-specific analysis, and environmental justice, which was not addressed in the GEIS.

Table 4-10. Environmental Justice and GEIS Category 2 Issues Applicable to Socioeconomics During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
	SOCIOECONOMICS		
Housing impacts	4.7.1	I	4.4.1
Public services: public utilities	4.7.3.5	I	4.4.2
Offsite land use (license renewal term)	4.7.4	I	4.4.3
Public services, transportation	4.7.3.2	J	4.4.4
Historic and archaeological resources	4.7.7	K	4.4.5
Environmental justice	Not addressed[(a)]	Not addressed[(a)]	4.4.6

(a) Guidance related to environmental justice was not in place at the time the GEIS and the associated revision to 10 CFR Part 51 were prepared. Therefore, environmental justice must be addressed in the NRC staff's SEIS.

4.4.1 Housing Impacts During Operations

In determining housing impacts, the applicant chose to follow Appendix C of the GEIS (NRC 1996), which presents a population characterization method that is based on two factors, "sparseness" and "proximity" (GEIS Section C.1.4 [NRC 1996]). Sparseness measures population density within 20 mi of the site, and proximity measures population density and city size within 50 mi. Each factor has categories of density and size (GEIS Table C.1), and a matrix is used to rank the population category as low, medium, or high (GEIS Figure C.1).

In 2000, 434,476 people were living within 20 mi of OCNGS, for a density of 610 persons/mi^2. This density translates to Category 4 (least sparse), using the GEIS measure of sparseness (AmerGen 2005a). At the same time, 4,243,462 persons were living within 50-mi of the plant, for a density of 1132 persons/mi^2. The NRC proximity matrix assigns a Category 4 rating (in close proximity) for this measure as well. The combined spareness and proximity categories indicate a "high population area." Although there are no growth controls that would limit housing development in this area, planning goals and objectives at the county and township level encourage balanced residential and commercial development (see Section 2.2.8.3).

10 CFR Part 51, Subpart A, Appendix B, Table B-1, states that impacts on housing availability are expected to be of small significance at plants located in a high population area where growth-control measures are not in effect. The OCNGS site is located in a high population area, and Ocean County is not subject to growth-control measures that would limit housing development. Based on the NRC criteria, AmerGen expects housing impacts to be SMALL during the license renewal period (AmerGen2005a).

SMALL impacts result when no discernible change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no housing construction or conversion is required to meet new demand (NRC 1996). The AmerGen ER assumes that an additional staff of 60 permanent workers might be needed during the license renewal period to perform routine maintenance and other activities.

The housing vacancy rate in 2000 was 19.4 percent in Ocean County (USCB 2005a). If these vacancy rates continue, small increases in the number of workers required at the plant would not require any new housing construction.

The NRC staff reviewed the available information relative to housing impacts and AmerGen's conclusions. Based on this review, the NRC staff concludes that the impact on housing during the license renewal period would be SMALL, and additional mitigation is not warranted.

4.4.2 Public Services: Public Utility Impacts During Operations

Impacts on public utility services are considered SMALL if there is little or no change in the ability of the system to respond to the level of demand, and thus there is no need to add new facilities or infrastructure. Impacts are considered MODERATE if overtaxing of service capabilities occurs during periods of peak demand. Impacts are considered LARGE if existing levels of service (e.g., water or sewer services) are substantially degraded and additional capacity is needed to meet ongoing demands for services. The GEIS indicates that, in the absence of new and significant information to the contrary, the only impacts on public utilities that could be significant are impacts on public water supplies (NRC 1996).

Analysis of impacts on the public water supply system considered both plant demand and plant-related population growth. Section 2.2.2 describes the OCNGS-permitted withdrawal rate and actual use of water.

The NRC staff has reviewed the available information, including permitted and actual water-use rates at OCNGS, and water-use and water supply capacities for the major water supply systems in Ocean County. Based on this information, the NRC staff concludes that the potential impacts of OCNGS operation during the license renewal period would be SMALL. During the course of its evaluation, the NRC staff considered mitigation measures for continued operation of OCNGS. Based on this evaluation, the NRC staff determined that mitigation measures in place at OCNGS are appropriate, and that no additional mitigation measures are warranted.

4.4.3 Offsite Land Use During Operations

Offsite land use during the license renewal term is a Category 2 issue (10 CFR Part 51, Subpart A, Appendix B, Table B-1). Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, notes that “significant changes in land use may be associated with population and tax revenue changes resulting from license renewal.”

Section 4.7.4 of the GEIS defines the magnitude of land-use changes as a result of plant operation during the license renewal term as follows:

SMALL – Little new development and minimal changes to an area’s land-use pattern.

MODERATE – Considerable new development and some changes to the land-use pattern.

LARGE – Large-scale new development and major changes in the land-use pattern.

Tax revenue can affect land use because it enables local jurisdictions to provide the public services (e.g., transportation and utilities) necessary to support development. Section 4.7.4.1 of the GEIS states that the assessment of tax-driven land-use impacts during the license renewal term should consider (1) the size of the plant’s payments relative to the community’s total revenues, (2) the nature of the community’s existing land-use pattern, and (3) the extent to which the community already has public services in place to support and guide development. If the plant’s tax payments are projected to be small relative to the community’s total revenue, tax-driven land-use changes during the plant’s license renewal term would be SMALL, especially where the community has pre-established patterns of development and has provided adequate public services to support and guide development. Section 4.7.2.1 of the GEIS states that if tax payments by the plant owner are less than 10 percent of the taxing jurisdiction’s revenue, the significance level would be SMALL. If the plant’s tax payments are projected to be medium to large relative to the community’s total revenue, new tax-driven land-use changes would be MODERATE. If the plant’s tax payments are projected to be a dominant source of the community’s total revenue, new tax-driven land-use changes would be LARGE. This would be especially true where the community has no pre-established pattern of development or has not provided adequate public services to support and guide development.

Lacey and Ocean Townships receive tax payments from AmerGen. AmerGen paid an average of $1.9 million annually in property taxes to Lacey Township over the 3-year period from 2002 to 2004, or approximately 4 percent of the township's revenues. Ocean Township received an average of $0.01 million annually from taxes paid by AmerGen over the same 3-year period. These payments represent a small, positive impact on the fiscal condition of the township.

Because no refurbishment or new construction activities are associated with the license renewal, no additional sources of plant-related tax payments are expected that could influence land use in the township or the county. The continued collection of property taxes from OCNGS will result in small indirect tax-driven land-use impacts through sewer and water system improvements and expansion, lower property taxes, and improved educational services and facilities. This source of revenue allows the township, school district, and county to keep tax rates below the levels they would otherwise have in order to fund the higher levels of public infrastructure and services, schools, and government services.

Ocean County's population growth rates over the last 30 years have been rapid (Table 2-10). AmerGen projects that 60 additional employees would be needed to support OCNGS operations during the license renewal term; thus, land-use changes from OCNGS population-related growth would be negligible. While the county has experienced significant residential, industrial, and commercial growth during this 30-year period, the importance of balanced residential and commercial development and the importance of environmental protection is reflected in the planning goals and objectives at the county (NRC 2006) and township level (Township of Lacey 1991).

AmerGen projects that annual property taxes from OCNGS to Lacey and Ocean Townships will remain relatively constant throughout the license renewal period. However, the New Jersey Public Service Commission is currently implementing electric utility restructuring legislation that was enacted in June 2000, and the impacts are not fully known at this time. Any changes to the OCNGS tax rates due to the restructuring would be independent of license renewal (AmerGen 2005a).

No adverse impacts on offsite land use would occur because of license renewal. Consequently, the NRC staff concludes that offsite land-use impacts would likely be SMALL, and additional mitigation is not warranted.

4.4.4 Public Services: Transportation Impacts During Operations

Table B-1, 10 CFR Part 51, states: "Transportation impacts (level of service) of highway traffic generated . . . during the term of the renewed license are generally expected to be of small significance. However, the increase in traffic associated with additional workers and the local road and traffic control conditions may lead to impacts of moderate or large significance at some sites." All applicants are required by 10 CFR Part 51.53(c)(3)(ii)(J) to assess the impacts of highway traffic generated by the proposed project on the level of service of local highways during the term of the renewed license.

Given the small number of additional workers required during the renewal period, there would be no detectable impacts on the transportation network in the vicinity of the OCNGS site.

4.4.5 Historic and Archaeological Resources

The National Historic Preservation Act (NHPA) requires that Federal agencies take into account the effects of their undertakings on historic properties. The historic preservation review process mandated by Section 106 of the NHPA is outlined in regulations issued by the Advisory Council on Historic Preservation at 36 CFR Part 800. Renewal of an OL is an undertaking that could potentially affect historic properties. Therefore, according to the NHPA, the NRC is to make a reasonable effort to identify historic properties in the areas of potential effects. If no historic properties are present or affected, the NRC is required to notify the State Historic Preservation Office (SHPO) before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve possible adverse effects of the undertaking.

AmerGen contacted the New Jersey SHPO on October 7, 2004, regarding preparation of its application for license renewal (AmerGen 2005a). The SHPO responded on October 15, 2004, that license renewal will not impact historic and archaeological properties. The NRC contacted the SHPO and five Native American Tribes on October 12, 2005. A representative from the SHPO responded to the NRC on November 2, 2005, reiterating the conclusion of the previous letter to the applicant (October 15, 2004) and expressing the requirement for further consultation only if additional activities become part of license renewal.

The NRC staff conducted a site file search for the OCNGS property at the SHPO in Trenton, New Jersey, on October 13, 2005. Although, to date, no surveys have been conducted at the OCNGS site and the potential exists for cultural resources to be present within the site boundaries, it does not appear that the proposed license renewal would adversely affect cultural resources. The applicant has indicated that no refurbishment or replacement activities (including additional land-disturbing activities) at the plant site (or along the existing transmission line corridor) are planned for the license renewal period (AmerGen 2005a). Therefore, continued operation of OCNGS would likely protect any cultural resources present within the OCNGS site boundary by protecting those lands from development and providing secured access. However, because there is the potential for cultural resources to be present at the site and along the OCNGS-to-Manitou transmission line, the applicant should take care during normal operations and maintenance activities not to inadvertently affect cultural resources. To avoid such adverse impacts, any ground-disturbing activity in an undisturbed area should be preceded by an evaluation of cultural resources in consultation with the

New Jersey SHPO and appropriate Native American Tribes as required under Section 106 of the NHPA. Environmental review procedures that include consultation are in place at OCNGS regarding undertakings that would disturb previously undisturbed soils or sediments at or below the surface in order to ensure the protection of cultural resources.

Based on this analysis of cultural resources, the NRC staff concludes that the impact of continued operation of the OCNGS during the license renewal period would be SMALL, and that further mitigation is not necessary.

4.4.6 Environmental Justice

Environmental justice refers to a Federal policy that requires that Federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its actions on minority[(a)] or low-income populations. The memorandum accompanying Executive Order 12898 (59 FR 7629) directs Federal executive agencies to consider environmental justice under the National Environmental Policy Act of 1969 (NEPA). The Council on Environmental Quality (CEQ) has provided guidance for addressing environmental justice (CEQ 1997). Although the Executive Order is not mandatory for independent agencies, the NRC has voluntarily committed to undertake environmental justice reviews. Specific guidance is provided in NRC Office of Nuclear Reactor Regulation Office Instruction LIC-203, *Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues Rev. 1* (NRC 2004a). In 2004, the Commission issued a final *Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions* (NRC 2004b).

The scope of the review, as defined in NRC guidance (NRC 2004a), includes identification of impacts on minority and low-income populations, the location and significance of any environmental impacts during operations on populations that are particularly sensitive, and information pertaining to mitigation. It also includes evaluation of whether these impacts are likely to be disproportionately high and adverse.

The NRC staff looks for minority and low-income populations within a 50-mi radius of the site. For the NRC staff's review, a minority population exists in a census block group[(b)] if the

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(a) The NRC guidance for performing environmental justice reviews defines "minority" as American Indian or Alaskan Native; Asian; Native Hawaiian or other Pacific Islander; Black races; or Hispanic ethnicity. "Other" races and multiracial individuals may be considered as separate minorities (NRC 2004a).

(b) A census block group is a combination of census blocks, which are statistical subdivisions of a census tract. A census block is the smallest geographic entity for which the U.S. Census Bureau (USCB) collects and tabulates decennial census information. A census tract is a small, relatively permanent statistical subdivision of counties delineated by local committees of census data users in accordance percentage of each minority and aggregated minority category within the census block group exceeds the corresponding percentage of minorities in the State of which it is a part by 20 percentage points, or the corresponding percentage of minorities within the census block group is at least 50 percent. A low-income population exists if the percentage of low-income population within a census block group exceeds the corresponding percentage of low-income population in the State of which it is a part by 20 percent, or if the corresponding percentage of low-income population within a census block group is at least 50 percent.

For the OCNGS review, the NRC staff examined the geographic distribution of minority and low-income populations within 50 mi of the site, employing data from the 1990 Census for low-income populations and the 2000 Census for minority populations (USCB 2005b). The analysis was supplemented by field inquiries to the planning department and social service agencies in Ocean County.

Figures 4-1 and 4-2 show the geographic distribution of census block groups for the minority and low-income populations within 50 mi of the site, respectively. A number of block groups within Ocean County exceed the NRC thresholds defining minority; these are located in Lakewood Township to the north of OCNGS. Other block groups exceeding the thresholds within the 50-mi region are located in Philadelphia County, Pennsylvania, and Camden, Middlesex and Mercer Counties in New Jersey. Census block groups exceeding the thresholds defining a low-income population within Ocean County also are located in Lakewood Township. Block groups exceeding the thresholds for low-income within the 50-mi region are located in Philadelphia County, Pennsylvania, and Camden, Mercer, and Monmouth Counties in New Jersey.

With the locations of minority and low-income populations identified, the NRC staff proceeded to evaluate whether any of the environmental impacts of the proposed action could affect these populations in a disproportionately high and adverse manner. Based on NRC staff guidance (NRC 2001), air, land, and water resources within about 50 mi of the OCNGS site were examined. Within that area, all of the potential environmental impacts were considered SMALL.

The pathways through which the environmental impacts associated with OCNGS license renewal can affect human populations are discussed in each topical section. The NRC staff evaluated whether minority and low-income populations could be disproportionately affected by these impacts. The NRC staff found no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing that would be affected and, in turn, adversely affect minority and low-income populations. In addition, the NRC staff did not identify any location-dependent disproportionately high and adverse impacts affecting these minority and

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with USCB guidelines for the purpose of collecting and presenting decennial census data. Census block groups are subsets of census tracts (USCB 2005b).

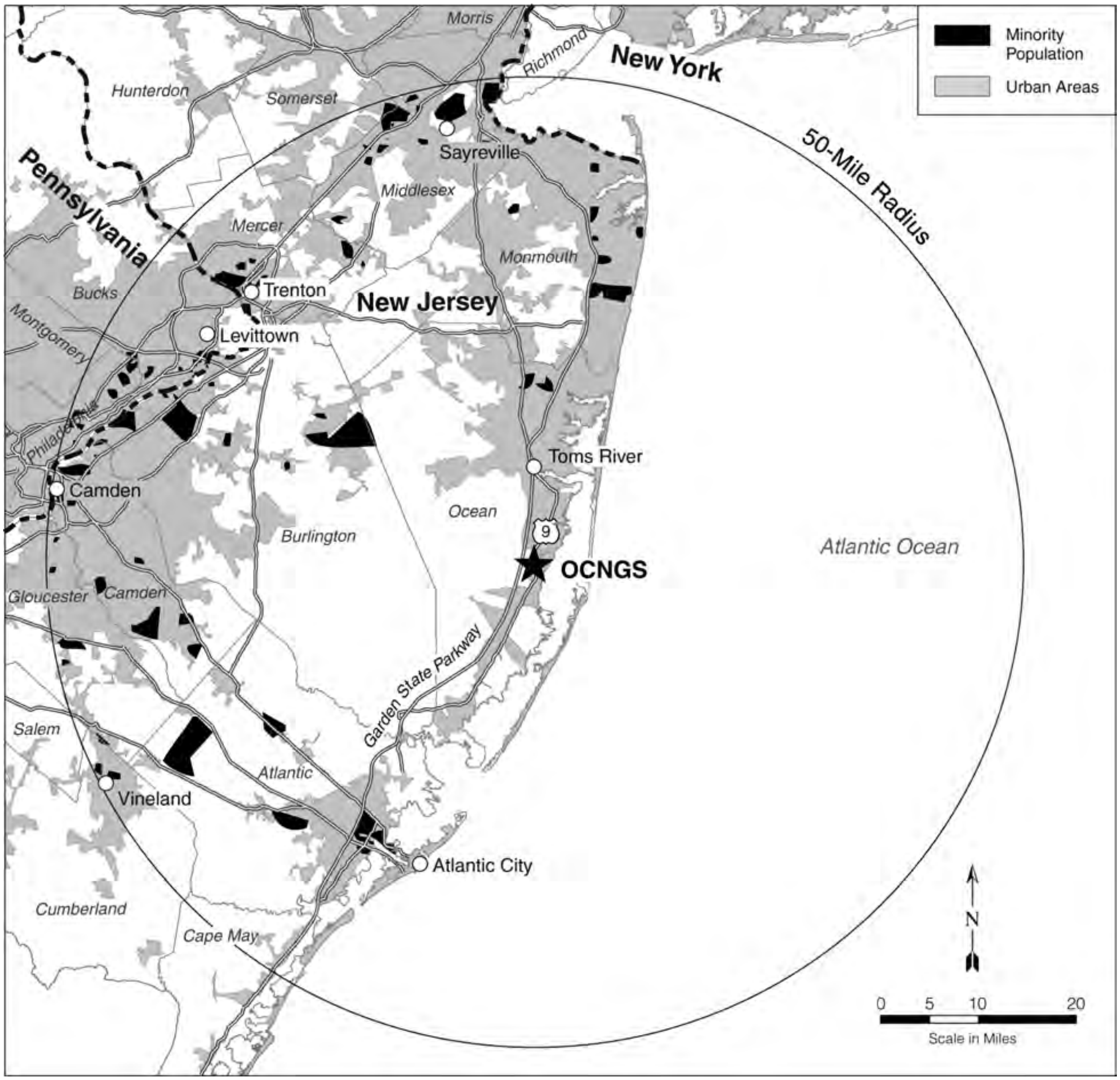

Figure 4-1. Geographic Distribution of Minority Populations (shown in shaded areas) Within 50 mi of the Oyster Creek Nuclear Generating Station Based on Census Block Group Data

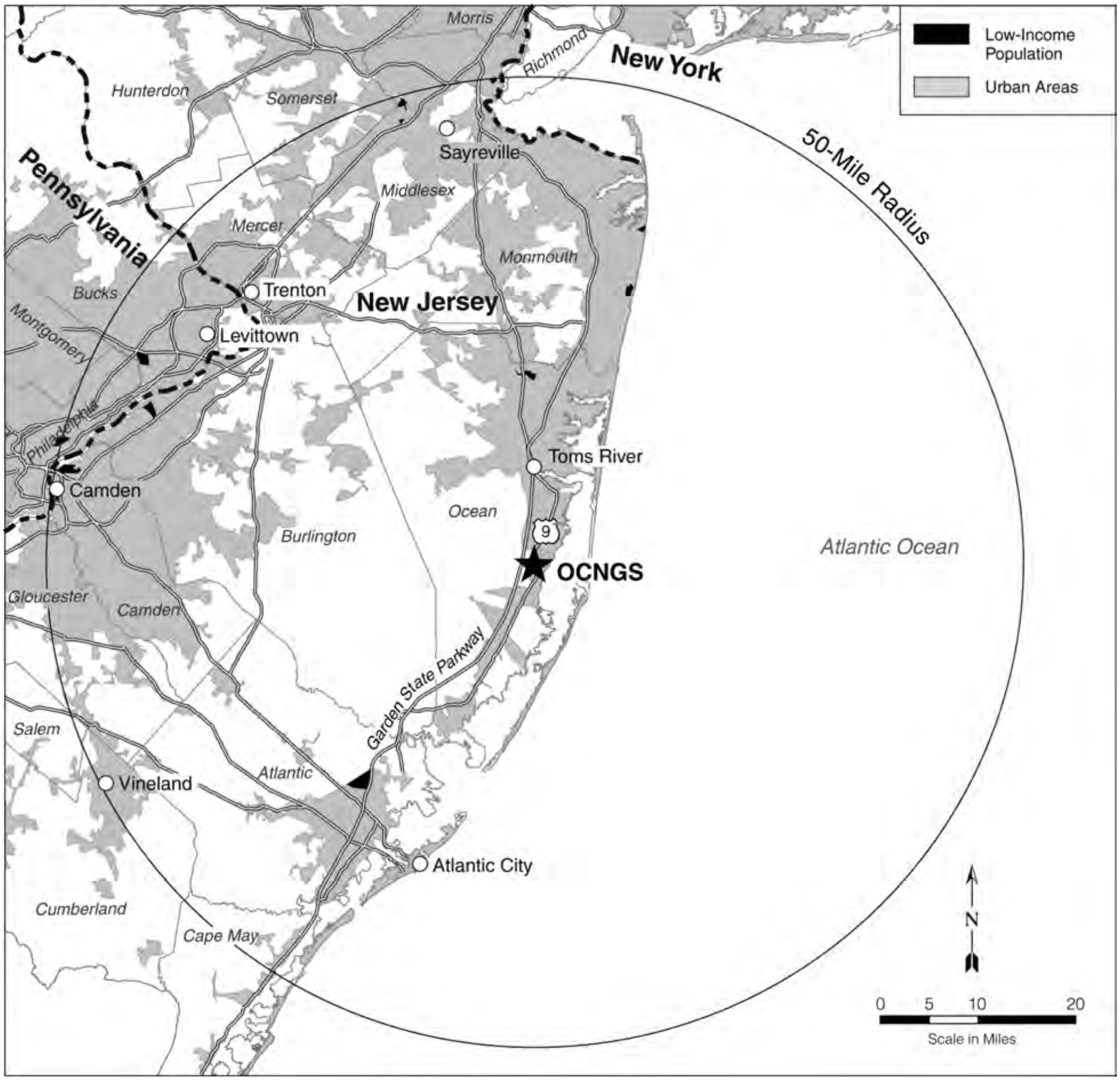

Figure 4-2. Geographic Distribution of Low-Income Populations (shown in shaded areas) Within 50 mi of the Oyster Creek Nuclear Generating Station Based on Census Block Group Data

low-income populations. The NRC staff concludes that offsite impacts from OCNGS on minority and low-income populations would be SMALL, and no special mitigation actions are warranted.

4.5 Groundwater Use and Quality

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to OCNGS groundwater use and quality are listed in Table 4-11. AmerGen stated in its ER that it is not aware of any new and significant information associated with the renewal of the OCNGS OL (AmerGen 2005a). The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no impacts related to these issues beyond those discussed in the GEIS. For these issues, the GEIS concluded that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-11. Category 1 Issues Applicable to Groundwater Use and Quality During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
GROUNDWATER USE AND QUALITY	
Groundwater-use conflicts (potable and service water; plants that use <100 gpm)	4.8.1.1
Groundwater quality degradation (saltwater intrusion)	4.8.2.1

A brief description of the NRC staff's review and the GEIS conclusions, as codified in 10 CFR Part 51, Table B-1, follows.

- Groundwater-use conflicts (potable and service water; plants that use <100 gpm). Based on information in the GEIS, the Commission found that

  > Plants using less than 100 gpm are not expected to cause any groundwater-use conflicts.

  As discussed in Section 2.2.2, OCNGS groundwater use is less than 100 gpm. The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no groundwater-use conflicts during the renewal term beyond those discussed in the GEIS.

- Groundwater-quality degradation (saltwater intrusion). Based on information in the GEIS, the Commission found that

  Nuclear power plants do not contribute significantly to saltwater intrusion.

  The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there would be no groundwater-quality degradation impacts associated with saltwater intrusion during the renewal term beyond those discussed in the GEIS.

There are no Category 2 issues related to groundwater use and quality for OCNGS.

4.6 Threatened or Endangered Species

Threatened or endangered species are listed as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue is listed in Table 4-12.

This issue requires consultation with appropriate agencies to determine whether threatened or endangered species are present and whether they or their critical habitat would be adversely affected by continued operation of the nuclear plant during the license renewal term. The presence of threatened or endangered species or their critical habitat in the vicinity of the OCNGS site is discussed in Sections 2.2.5.5 and 2.2.6.2.

Table 4-12. Category 2 Issue Applicable to Threatened or Endangered Species During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section	10 CFR Part 51.53(c)(3)(ii) Subparagraph	SEIS Section
THREATENED OR ENDANGERED SPECIES (FOR ALL PLANTS)			
Threatened or endangered species	4.1	E	4.6

On October 12, 2005, the NRC contacted the FWS and the NMFS to request information on Federally listed threatened and endangered species and the impacts of license renewal (NRC 2005a,b). In response, on November 23, 2005, the FWS concluded that the proposed project would not adversely affect Federally listed species under the FWS's jurisdiction (FWS 2005). The NRC had recently concluded an Endangered Species Act (ESA) Section 7 consultation with the NMFS regarding sea turtle impingement at the OCNGS intake (NMFS 2005). The NMFS plans to use the information in this SEIS to update its Biological Opinion (BO) and relate it to the license renewal term for continued operation of OCNGS.

4.6.1 Aquatic Species

Aquatic species that are Federally listed as threatened or endangered and that occur in the vicinity of OCNGS or the OCNGS-to-Manitou transmission line are limited to five species of sea turtles. These species include the loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), and green (*Chelonia mydas*) sea turtles. There are no Federally listed fish or marine mammal species, nor are there any Federally designated critical habitats in the project area.

The primary threat of OCNGS operations to listed sea turtle species is impingement on the trash racks associated with the once-through cooling system. In 2004, OCNGS exceeded the incidental take limit for Kemp's ridley sea turtles, which resulted in a Section 7 consultation (NRC 2005c) with the NMFS. The Incidental Take Statement (ITS) in the NMFS BO (NMFS 2005) established specific take[a] limits for each species. These limits specify the number of individuals of each species that can be taken at OCNGS, and the number of allowed mortalities associated with these takes. Take limits established in the 2005 ITS are two loggerhead sea turtles (no more than one lethal), eight Kemp's ridley sea turtles (no more than four lethal), and one green sea turtle (no more than one lethal). OCNGS is required to notify the NRC and the NMFS of any captures of a sea turtle associated with OCNGS operations. Most impinged turtles at OCNGS are impinged on the trash racks associated with either the circulating-water or dilution-water intake systems.

Standardized protocols have been developed in conjunction with the NMFS to ensure that turtles are safely removed from the intakes, evaluated to determine whether they are alive or dead, identified to determine species and life stage, and examined for boat propeller wounds or other trauma. If recovered turtles are comatose or appear dead, resuscitation is attempted. If resuscitation is unsuccessful, arrangements are made to send the turtle for necropsy. Past difficulties in the preparation, storage, and shipping of turtles for necropsy have resulted in the loss of important data concerning the cause of death; recently, however, OCNGS procedures have been revised to correct these problems.

When a live turtle is captured, the turtles are taken to the Marine Mammal Stranding Center (MMSC) in Brigantine, New Jersey, by OCNGS Environmental Affairs Department personnel. MMSC determines if, when, and where the captured turtle can be released to the wild, and makes the necessary arrangements. The details of each sea turtle capture are provided in Annual Environmental Operating Reports that OCNGS submits to the NRC.

Sea turtle capture and mortality data at OCNGS from 1969 to 2005 are summarized in

(a) Take is defined in ESA Section 3(19) as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct."

Table 4-13. No sea turtle captures were reported at the OCNGS circulating-water or dilution-water intakes from 1969 to 1991, and no captures of leatherback or hawksbill sea turtles have been reported since the plant began operating. Beginning in 1992, loggerhead and

Table 4-13. Sea Turtles Impinged on Intake Trash Racks at OCNGS, 1969 to 2005

	Number of Individual Turtles Impinged (no. live/no. dead)			
Year	**Loggerhead**	**Kemp's Ridley**	**Green**	**Totals**
1969 to 1991	0/0	0/0	0/0	0/0
1992	1/1	1/0	0/0	2/1
1993	0/0	0/1	0/0	0/1
1994	1/1	0/2	0/0	1/3
1995	0/0	0/0	0/0	0/0
1996	0/0	0/0	0/0	0/0
1997	0/0	0/1	0/0	0/1
1998	1/0	0/0	0/0	1/0
1999	0/0	1/0	0/1	1/1
2000	2/0	1/1	1/0	4/1
2001	0/0	0/2	1/0	1/2
2002	0/0	2/0	0/0	2/0
2003	0/0	1/0	1/0	2/0
2004	0/0	5/3	0/0	5/3
2005	0/0	1/1	0/0	1/1
Totals	5/2	12/11	3/1	20/14

Source: NRC 2005c

Kemp's ridley sea turtle captures began to occur at OCNGS. Green sea turtle captures began in 1999 (Table 4-13). Since 1992, 34 sea turtles have been captured, including 7 loggerhead sea turtles (5 alive, 2 dead), 23 Kemp's ridley (12 alive, 11 dead), and 4 green (3 alive, 1 dead). The reasons for the appearance of sea turtles at or near the intakes of OCNGS beginning in 1992 is unknown. One possible explanation is the increase in access to Barnegat Bay resulting from modifications to Barnegat Inlet by the U.S. Army Corps of Engineers that began in 1988, including the completion of a new alignment of the south jetty in 1991, and significant dredging and deepening of the Barnegat Inlet from 1991 to 1993 (NRC 2005c). It is also possible that the increased captures are related to an overall regional increase in sea turtle abundance based on stranding data from New Jersey coastal and estuarine waters.

Based on the 2005 consultation, the NRC staff has concluded that the impacts on threatened or endangered sea turtles from continued operation of OCNGS during the license renewal term would be SMALL, and that additional mitigation is not warranted.

4.6.2 Terrestrial Species

The FWS (2005) stated that, except for an occasional transient bald eagle (*Haliaeetus leucocephalus*), no other Federally listed or proposed threatened or endangered species or critical habitat under FWS jurisdiction are known to occur within the OCNGS area, and that the proposed project would not adversely affect Federally listed species or critical habitat under FWS jurisdiction (FWS 2005).

Bald eagles in New Jersey are mostly associated with the Delaware River and Bay and rivers that flow into the Atlantic Ocean and Delaware Bay (NJDEP 2004). However, the bald eagle is an occasional transient near the project area, and it is possible that a pair could nest on or adjacent to the OCNGS site during the license renewal period (FWS 2005). It would be expected that any bald eagle activity near OCNGS would be centered within Barnegat Bay, rather than more inland where the OCNGS-to-Manitou transmission line right-of-way is located. Transmission lines pose a potential collision hazard to migrant and resident bird species, including those that are Federally listed such as the bald eagle. In the GEIS, the NRC accessed the impacts of transmission lines on avian populations (NRC 1996). The NRC concluded that mortality resulting from bird collisions with transmission lines associated with an additional 20 years of operation would be of SMALL significance. This conclusion was based on (1) no indication in the existing literature that collision mortality is high enough to result in population-level impacts, and (2) the lack of known instances where nuclear power plant lines affect large numbers of individuals in local areas. See Section 4.2 of this SEIS for a related discussion of this topic. Continued operation of OCNGS and operation and maintenance of the OCNGS-to-Manitou transmission line during the license renewal period are not likely to adversely affect the bald eagle.

Therefore, the NRC staff concludes that the impact on threatened or endangered terrestrial species of an additional 20 years of operation of OCNGS and the OCNGS-to-Manitou transmission line would be SMALL, and that further mitigation would not be warranted.

4.7 Evaluation of New and Potentially Significant Information on Impacts of Operations During the Renewal Term

The NRC staff reviewed the discussion of environmental impacts in the GEIS and conducted its own independent review (including comments received during the scoping period) to identify new and significant information on environmental issues listed in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, related to operation of OCNGS during the renewal term. Processes for identification and evaluation of new information are described in Section 1.2.2. Several issues were raised during scoping that are examined here to determine whether they represent new and significant information.

An emergency fire pond was built during the original construction of the OCNGS facility. This 8.5-ac pond was created by impounding Oyster Creek upstream of the discharge canal to provide water for fighting fires at the facility. In its scoping comments, the FWS noted that "it appears that Oyster Creek was a functioning waterway capable of supporting fish passage and possibly spawning habitat. Oyster Creek has the potential to offset expected adverse impacts from the proposed license renewal via the construction of a fish ladder" (FWS 2005). The existing dam may form a barrier to migratory anadromous or catadromous species such as the American shad (*Alosa sapidissima*) or the American eel (*Anguilla rostrata*); however, there is no evidence to suggest that shad are currently using the creek as a spawning or nursery area. The American eel was reported as present in Oyster Creek and the Forked River in the FESs for the Forked River Nuclear Station Unit 1 (AEC 1973) and for OCNGS (AEC 1974). American shad, considered a coolwater migrant of Barnegat Bay (Tatham et al. 1984), were not reported as being present in either Oyster Creek or the Forked River in either report. An NJDEP review of anadromous fish spawning runs in New Jersey conducted in the late 1970s found no evidence of American shad spawning runs in Oyster Creek. Also, the fire pond dam would not hinder upstream migration of elvers.

The upper reaches of Oyster Creek are currently relatively undeveloped and may represent an opportunity for the development of anadromous and catadromous fish runs. However, the NRC staff considers the issue of the presence of the fire pond dam and the potential blockage of fish passage outside of the scope of license renewal, because the existence of the pond is unaffected by the decision to renew the license. Additionally, although AmerGen maintains and operates the fire pond, it is on land owned by First Energy or its subsidiaries. The NRC staff considers it appropriate for the owners of the fire pond to work directly with the State and Federal agencies to evaluate the desirability of improving fish passage over the dam.

During the scoping period, a member of the public brought up the issue of sediment deposition patterns in the Forked River and expressed concern that this deposition has resulted in navigation problems at some of the entrances to the finger canals along the river. The impacts associated with alteration of current patterns due to station operations were considered in the GEIS. Section 4.2.1.2.1 of the GEIS specifically discusses the operation of OCNGS with respect to the impacts associated with the alteration of flow in both Forked River and Oyster Creek. The GEIS states that substantial hydrological and water-quality changes in Forked River and Oyster Creek resulted in only minor effects in Barnegat Bay. Also according to the GEIS, "changes to current patterns are of small significance if they are localized near the intake and discharge of the power plant and do not alter water use or hydrology in the wider area." The NRC staff finds that the GEIS addressed the issue of sediment transport and finds that no new and significant information exists to suggest that the conclusion in the GEIS is no longer valid. Although the GEIS found that the alteration of current patterns was of small significance for this specific facility, the fact remains that the shoaling at the mouth of the finger canals, that is quite possibly the result of station operations, is impeding pleasure boat use for people along the affected canals. Mitigation of this impact is beyond the scope of license renewal. The staff recommends that the homeowners work with the applicant to resolve this issue.

The NRC staff has identified a new issue that was not previously addressed in the GEIS related to essential fish habitat (EFH). The consultation requirements of Section 305(b) of the Fishery Conservation and Management Act (FCMA) provide that Federal agencies must consult with the Secretary of Commerce on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH. Concurrent with issuance of this SEIS, the NRC staff has requested initiation of an EFH consultation with the NMFS. The EFH Assessment to support this consultation is presented in Appendix E of this SEIS.

4.8 Cumulative Impacts

The NRC staff considered potential cumulative impacts in its environmental analysis of operations of OCNGS. For the purposes of this analysis, past actions are those related to the resources at the time of the plant licensing and construction, present actions are those related to the resources at the time of current operation of the power plant, and future actions are considered to be those that are reasonably foreseeable through the end of plant operation, which would include the 20-year license renewal term. The geographic area over which past, present, and future actions would occur is dependent on the type of action considered and is described below for each impact area.

The impacts of the proposed action, as described in Sections 4.1 through 4.6, are combined with other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. These combined impacts are defined as "cumulative" in 40 CFR 1508.7 and include individually minor but collectively significant actions taking place over a period of time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

4.8.1 Cumulative Impacts on Aquatic Resources

The geographic area considered for the analysis of the cumulative impacts on aquatic resources focused on Oyster Creek, Forked River, and Barnegat Bay. There is limited industrial and urban development in other portions of the Oyster Creek and Forked River watersheds.

Large estuaries are influenced by a variety of factors that alter marine and estuarine food webs, species compositions, or species distributions that are ecologically, commercially, or recreationally important. OCNGS is the largest point-source discharger in the Barnegat Bay estuary. However, impacts related to plant operations are localized and have less impact than those related to, for example, long-term regional land use changes. It is likely that plant operations contribute to some of the environmental concerns found in Barnegat Bay; the precise contribution, however, cannot be quantified without long-term studies of the estuary.

The 2005 State of the Estuary Report (BBNEP 2005) identified a variety of anthropogenic stressors to the estuary that were not associated with OCNGS. Degraded water quality has been attributed to nutrient loading associated with nearshore development and the presence of bacterial contamination from failed septic systems. Changes in ecosystem structure and function may be the result of many factors, including the loss of wetland and salt marsh areas due to dredging, filling, and nearshore development, and climatic changes that alter predator-prey relationships or species compositions. The emergence of harmful algal blooms is causally linked to declines in SAV, and both phenomena may be responses to changes in estuary hydrodynamics related to dredging, channel improvement programs, and loss of coastal habitat due to diking and filling activities.

Expected changes to Forked River and Oyster Creek during the license renewal term include maintenance dredging associated with the intake and discharge canals to facilitate water flow. Expected changes or modifications to Barnegat Bay include as-needed maintenance dredging of the Intracoastal Waterway and periodic dredging of Barnegat Inlet. Barnegat Bay is also expected to be impacted by continued urbanization and development, including the construction of new over-water or near-water structures, and an increase in dikes and sheet pile walls. Expected future environmental impacts include the loss of sensitive habitat (e.g., salt marsh communities, SAV); continued nonpoint source impacts on the estuary from stormwater, runoff, and contaminated groundwater; increased eutrophication associated with nutrient inputs; and potential closures of beaches due to algal blooms or bacterial contamination. The above topics have been raised as important issues by local, State, and Federal resource agencies in Barnegat Bay and in other nearshore areas along the Atlantic seaboard.

During the construction of OCNGS in the late 1960s, the freshwater and low-salinity habitats associated with Oyster Creek and the South Branch of the Forked River at that time were destroyed. When the once-through cooling system began operation, the water requirements of the plant reversed the flow of the lower Forked River and increased the flow of lower Oyster Creek with the discharge of heated cooling water containing biocides, trace metals, and other chemicals. These alterations resulted in habitat loss in the lower portions of both Oyster Creek and the Forked River, and long-term changes to the water quality (temperature, salinity, and chemical contamination) of those areas. For the most part, the remainder of the Oyster Creek and Forked River watersheds are undeveloped.

The dam on Oyster Creek that was installed south of OCNGS to create a pond to meet the facility's needs for fire fighting may form a barrier to migratory anadromous or catadromous species (e.g., American shad or American eel). It is possible that future consultation with the FWS may result in a modification to this structure to allow for fish passage.

Maintenance dredging at OCNGS and dredging associated with local docks and marinas will continue to occur and contribute to cumulative impact. Runoff associated with U.S. Highway 9 and residences along the Forked River and Oyster Creek represents a potential ongoing impact, but the extent and magnitude are unknown. No other past, present, or future activities have been identified that could alter the physical and chemical condition of Oyster Creek and the Forked River.

Physical and chemical cumulative impacts on Barnegat Bay have occurred as a result of jetty realignment and maintenance dredging of Barnegat Inlet and the Intracoastal Waterway. Increased development in nearshore locations causes impacts related to habitat loss and chemical pollution consistent with urbanized waterways. Impacts associated with the seasonally large number of recreational vessels on Barnegat Bay may adversely affect abundance, distribution, and habitat of aquatic resources in the estuary. These impacts are expected to continue to occur in Barnegat Bay during the license renewal term.

Cumulative impacts on the aquatic food web could include the loss of important phytoplankton and zooplankton species due to entrainment into the OCNGS once-through cooling system, and from exposure to heated cooling water containing biocides and other chemicals. On the basis of the information reviewed in EA (1986), Summers et al. (1989), BBNEP (2001), and Kennish (2001), there is no evidence to suggest that the operation of the OCNGS cooling-water system has significantly altered the marine and estuarine food web in Barnegat Bay or resulted in significant changes in phytoplankton or zooplankton species compositions, except in areas restricted to the Forked River and Oyster Creek.

Like most eastern urbanized estuaries, Barnegat Bay is subject to a variety of environmental stressors that contribute to cumulative impacts. For example, harmful algal blooms have occurred in Barnegat Bay during the past two decades, it does not appear that OCNGS operations are contributing to the outbreaks. Rather, it is likely that some harmful algal species are responding to increased nutrient loading in the estuary because of nonpoint source pollution associated with coastal development, while others are responding to the salinity and temperature changes in the bay associated with recent navigational improvements to Barnegat Inlet. Further baywide investigations at the ecosystem level are needed to adequately assess long-term cumulative impacts on Barnegat Bay.

Operation of the OCNGS once-through cooling system may adversely affect ecologically, commercially, or recreationally important species. Impacts may include entrainment of small life stages, impingement of juvenile or adult forms, toxicity due to exposure to chemicals associated with the cooling-water discharge, or toxicological or behavioral changes associated with exposure to heated water in the discharge canal or in areas of Barnegat Bay influenced by the thermal plume. In its 2005 fact sheet accompanying the draft NJDEP permit, the NJDEP (2005) identified a variety of representative important species that may be impacted by the operation of the OCNGS cooling system. It was assumed that the impacts demonstrated for these surrogate species would be applicable to other species and scalable to both population and ecosystem levels. Species identified included representatives of important fish [winter flounder (*Pseudopleuronectes americanus*), bay anchovy (*Anchoa mitchilli*)], sand shrimp (*Crangon septemspinosa*), opossum shrimp (*Neomysis integer*), blue crab (*Callinectes sapidus*), hard clam (*Mercenaria mercenaria*), eelgrass (*Zostera marina*), shipworms (Family Teredinidae), and Kemp's ridley sea turtle. Summers et al. (1989) concluded that continued operation of OCNGS would not "threaten the protection and propagation of balanced, indigenous populations." This conclusion was supported by Kennish (2001), who stated "Despite the large numbers of eggs, larvae, and small life forms of Barnegat Bay organisms lost via in-plant passage at the OCNGS, these losses have not resulted in detectable impacts on biotic communities in Barnegat Bay. Effects of operation of OCNGS on aquatic communities appear to be restricted to the discharge canal and Oyster Creek." Factors other than OCNGS operation also affect fish and shellfish populations in Barnegat Bay. For example, fishing pressure affects several bay stocks, such as winter flounder, which is overfished and depleted.

Threatened or endangered aquatic species that may be affected by the operation of the OCNGS cooling system are limited to five species of sea turtles (loggerhead, Kemp's ridley, leatherback, hawksbill, and green; see Section 4.6.1 of this SEIS). In many cases, the dead sea turtles captured at OCNGS appeared to have died elsewhere, and in some cases, dead sea turtles exhibited wounds consistent with injuries from small boat propellers. The increase in sea turtle captures at OCNGS since 1992 may be related to navigation improvements at Barnegat Inlet, which allow easier passage into Barnegat Bay, or an overall increase in sea turtle populations along the New Jersey coast. Recently, the NRC consulted with the NMFS to revisit the incidental take statement for sea turtles at OCNGS, given the increased prevalence of some species in coastal New Jersey waters and the exceedence of allowed takes of Kemp's ridley turtles in 2004. The results of the consultation produced a revised incidental take limit that is consistent with population abundances and designed to ensure that the species are protected.

Because the Barnegat Bay estuary is influenced by many controlling factors, the incremental contribution of OCNGS operations cannot be quantified precisely without additional investigation. It is likely, however, that OCNGS impacts are localized and have a minimal contribution to cumulative impact to the Barnegat Bay estuary. The NRC staff concludes that the cumulative impact of continued operation of the OCNGS once-through cooling system on aquatic resources in the Barnegat Bay estuary would be SMALL, and that no further mitigation would be warranted.

4.8.2 Cumulative Impacts on Terrestrial Resources

This section analyzes past, present, and future actions that could result in adverse cumulative impacts on terrestrial resources, including wildlife populations, upland habitat, wetlands, floodplains, and land use. For the purposes of this analysis, the geographic area that encompasses the past, present, and foreseeable future actions that could contribute to adverse cumulative impacts on terrestrial resources includes Ocean County, which contains OCNGS and its associated transmission line.

Past land use changes include construction of the OCNGS facility and the OCNGS-to-Manitou transmission line. Substantial residential and commercial development has occurred in the area since OCNGS was constructed, and this development is expected to continue (see Section 2.2.8.3). Development in Lacey Township and Ocean County is governed by master plans that favor balanced growth and environmental protection. In addition, those portions of the county that lie within the Pinelands National Reserve are managed under provisions of the Pinelands Protection Act, the intent of which is to protect the region from overdevelopment. The Pinelands Comprehensive Management Plan places restrictions on the density of development within the region.

As described in Section 2.1.7, the New Jersey Pinelands Commission will be issuing comprehensive vegetation-management guidelines for rights-of-way during 2007. The transmission line operator will incorporate these new guidelines into its vegetation-management practices. None of the management procedures are expected to alter wetland or floodplain hydrology or adversely affect vegetation characteristics of these habitats or other habitats.

Ten Federally listed threatened or endangered terrestrial species and one candidate for Federal listing are listed for Ocean County, but there is no critical habitat designated in the county (Section 2.2.6.2). Of these, the only species that could potentially be affected by OCNGS operations is the bald eagle. The bald eagle is only an occasional transient in the project area (FWS 2005), and OCNGS is not expected to contribute to cumulative impacts on this species.

The NRC staff concludes that the incremental contribution to cumulative impacts on terrestrial resources resulting from the continued operation of OCNGS and the OCNGS-to-Manitou transmission line would be SMALL, and that no additional mitigation would be warranted.

4.8.3 Cumulative Radiological Impacts

The radiological dose limits for protection of the public and workers have been developed by the EPA and the NRC to address the cumulative impact of acute and long-term exposure to radiation and radioactive material. These dose limits are codified in 40 CFR Part 190 and 10 CFR Part 20. For the purpose of this analysis, the area within a 50-mi radius region of interest (ROI) of the OCNGS site was included. There are no other nuclear fuel cycle facilities within the 50-mi ROI. The Hope Creek and Salem 1 and Salem 2 nuclear power plants are co-located in New Jersey approximately 75 mi southwest of OCNGS. The Limerick nuclear power plant is located in Pennsylvania, approximately 79 mi to the northwest of OCNGS. A portion of the population within the OCNGS ROI is also within the 50-mi ROIs for these other nuclear plants.

As stated in Section 2.2.7, AmerGen has conducted a radiological environmental monitoring program (REMP) around the OCNGS site since 1966, with the results presented annually in the OCNGS Annual Radiological Environmental Operating Report (AmerGen 2001b, 2002b, 2003b, 2004b, 2005c). The REMP measures radiation and radioactive materials from all sources, including, but not limited to, OCNGS emissions, and thus considers cumulative radiological impacts. On the basis of an evaluation of REMP results, the NRC staff concluded in Sections 2.2.7 and 4.3 that impacts of radiation exposure on the public and workers (occupational) from operation of OCNGS during the renewal term would be SMALL. With respect to the future, the REMP has not identified increasing levels or the accumulation of radioactivity in the environment over time. In addition, the staff is not aware of any plans or proposals for new nuclear facilities in the vicinity of OCNGS that would potentially contribute to cumulative radiological impacts. The NRC and the State of New Jersey would regulate any future actions in the vicinity of the OCNGS site that could contribute to cumulative radiological impacts. Therefore, the staff concludes that future cumulative radiological impacts would be SMALL, and that no further mitigation measures are warranted.

4.8.4 Cumulative Socioeconomic Impacts

For the analysis of cumulative socioeconomic impacts, the geographic range of analysis is Ocean County. When combined with the impact of other potential activities, such as likely residential development and population growth in the area surrounding the plant, socioeconomic impacts resulting from OCNGS license renewal would not produce a noticeable incremental change in any of the impact measures used. Therefore, the NRC staff determined that the impacts on employment, personal income, housing, local public services, utilities, and education occurring in the local socioeconomic environment as a result of license renewal activities, in addition to the impacts of other potential economic activity in the area, would be SMALL compared with other contributors. Additionally, the contribution of continued operation of the facility during the renewal period on transportation and environmental justice issues would likewise be SMALL. There are no reasonably foreseeable scenarios that would alter these conclusions in regard to cumulative impacts. Therefore, the staff concludes that future cumulative socioeconomic impacts would be SMALL, and that no further mitigation measures are warranted.

4.8.5 Cumulative Impacts on Groundwater Use and Quality

The geographic range of analysis for cumulative impacts on groundwater would encompass wells finished in the Cohansey aquifer and the Kirkwood Formation.

Groundwater in the region generally flows eastward to the coast, following the bedding of the coastal plain aquifers (URS 2005). Clay units are present throughout the subsurface with varied thicknesses and depths. Well users in the vicinity of OCNGS rely on wells that are at a minimum depth of approximately 60 to 70 ft (URS 2005). These wells tap the Cohansey aquifer at a depth sufficient to avoid saltwater intrusion or contamination from septic systems. Deeper wells are finished in the Kirkwood Formation, which has higher water quality. Shallower wells are also present but are generally used for lawn irrigation (URS 2005). On the OCNGS property, the canals influence the shallow groundwater system, resulting in shallow flow toward the canals (URS 2005).

The combined average groundwater pumping rate at OCNGS in 2001 was 14 gpm. This is well below the GEIS Category 2 threshold for groundwater use of 100 gpm. The facility does not have plans for further groundwater with development, either by increased pumping or additional extraction wells. Compared to regional water withdrawal rates and projected increases, OCNGS operational uses are considered inconsequential.

As described in Section 2.2.3 of this SEIS, site exceedences of groundwater standards have included petroleum hydrocarbons, volatile organic compounds, and methyl tertiary-butyl ether as documented and investigated during the Industrial Site Recovery Act process. However, the areal extent of contamination remains on the facility's property, and various remedial and monitoring systems operate under State regulation; therefore, the contamination will not contribute to offsite regional groundwater impacts.

On the basis of actual and planned pumping rates and the fact that increasing the groundwater extraction would require State approval, the NRC staff concludes that the cumulative impact on groundwater resources through water usage would be SMALL, and that additional mitigation would not be warranted. On the basis of groundwater quality, the NRC staff concludes that the cumulative impact on the quality of local groundwater resources also would be SMALL. Additional mitigation would not be warranted as long as monitoring and remediation continue, where necessary, under State regulatory oversight.

4.8.6 Conclusions Regarding Cumulative Impacts

The NRC staff considered the potential impacts resulting from operation of OCNGS during the license renewal term and other past, present, and future actions in the vicinity of OCNGS. The NRC staff's determination is that the potential cumulative impacts resulting from OCNGS operation during the license renewal term would be SMALL.

4.9 Summary of Impacts of Operations During the Renewal Term

Neither AmerGen nor the NRC staff is aware of information that is both new and significant related to any of the applicable Category 1 issues associated with OCNGS operation during the renewal term. Consequently, the NRC staff concludes that the environmental impacts associated with these issues are bounded by the impacts described in the GEIS. For each of these issues, the GEIS concluded that the impacts would be SMALL, and that additional plant-specific mitigation measures would not likely be sufficiently beneficial to warrant implementation.

Plant-specific environmental evaluations were conducted for 11 Category 2 issues applicable to OCNGS operation during the renewal term as well as for environmental justice and chronic effects of electromagnetic fields. For 10 issues and environmental justice, the NRC staff concludes that the potential environmental impact of renewal term operations of OCNGS would be of SMALL significance in the context of the standards set forth in the GEIS, and that additional mitigation would not be warranted. For Federally listed threatened and endangered species, the NRC staff’s conclusion is that the impact resulting from license renewal would be SMALL and that further investigation is not warranted. In addition, the NRC staff determined that a consensus has not been reached by appropriate Federal health agencies regarding chronic adverse effects from electromagnetic fields.

Cumulative impacts of past, present, and reasonably foreseeable future actions were considered, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. The NRC staff concluded that the impacts of continued operation of OCNGS during the license renewal period would not result in significant cumulative impacts on potentially affected resources.

4.10 References

10 CFR Part 20. *Code of Federal Regulations*, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 51. *Code of Federal Regulations*, Title 10*, Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

36 CFR Part 800. *Code of Federal Regulations*, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties."

40 CFR Part 190. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

40 CFR Part 1508. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 1508, "Terminology and Index."

69 FR 41575 July 9, 2004. "National Pollutant Discharge Elimination System-Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities." *Federal Register*, U.S. Nuclear Regulatory Commission.

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5.0 Environmental Impacts of Postulated Accidents

Environmental issues associated with postulated accidents are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective off-site radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and, therefore, additional plant-specific review of these issues is required.

This chapter describes the environmental impacts from postulated accidents that might occur during the license renewal term.

5.1 Postulated Plant Accidents

Two classes of accidents are evaluated in the GEIS. These are design-basis accidents and severe accidents, as discussed below.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and Addendum 1.

5.1.1 Design-Basis Accidents

In order to receive U.S. Nuclear Regulatory Commission (NRC) approval to operate a nuclear power facility, an applicant for an initial operating license (OL) must submit a Safety Analysis Report (SAR) as part of its application. The SAR presents the design criteria and design information for the proposed reactor and comprehensive data on the proposed site. The SAR also discusses various hypothetical accident situations and the safety features that are provided to prevent and mitigate accidents. The NRC staff reviews the application to determine whether the plant design meets the Commission's regulations and requirements and includes, in part, the nuclear plant design and its anticipated response to an accident.

Design-basis accidents (DBAs) are those accidents that both the licensee and the NRC staff evaluate to ensure that the plant can withstand normal and abnormal transients, and a broad spectrum of postulated accidents, without undue hazard to the health and safety of the public. A number of these postulated accidents are not expected to occur during the life of the plant, but are evaluated to establish the design basis for the preventive and mitigative safety systems of the facility. The acceptance criteria for DBAs are described in Title 10, Part 50 and Part 100, of the *Code of Federal Regulations* (10 CFR Part 50 and 10 CFR Part 100).

The environmental impacts of DBAs are evaluated during the initial licensing process, and the ability of the plant to withstand these accidents is demonstrated to be acceptable before issuance of the OL. The results of these evaluations are found in license documentation such as the applicant's Final Safety Analysis Report (FSAR), the NRC staff's Safety Evaluation Report (SER), the Final Environmental Statement (FES), and Section 5.1 of this Supplemental Environmental Impact Statement (SEIS). A licensee is required to maintain the acceptable design and performance criteria throughout the life of the plant, including any extended-life operation. The consequences for these events are evaluated for the hypothetical maximally exposed individual; as such, changes in the plant environment will not affect these evaluations. Because of the requirements that continuous acceptability of the consequences and aging management programs be in effect for license renewal, the environmental impacts as calculated for DBAs should not differ significantly from initial licensing assessments over the life of the plant, including the license renewal period. Accordingly, the design of the plant relative to DBAs during the extended period is considered to remain acceptable, and the environmental impacts of those accidents were not examined further in the GEIS.

The Commission has determined that the environmental impacts of DBAs are of SMALL significance for all plants because the plants were designed to successfully withstand these accidents. Therefore, for the purposes of license renewal, DBAs are designated as a Category 1 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. The early resolution of the DBAs makes them a part of the current licensing basis of the plant; the current licensing basis of the plant is to be maintained by the licensee under its current license and, therefore, under the provisions of 10 CFR 54.30, is not subject to review under license renewal. This issue, applicable to Oyster Creek Nuclear Generating Station (OCNGS), is listed in Table 5-1.

Table 5-1. Category 1 Issue Applicable to Postulated Accidents During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
POSTULATED ACCIDENTS	
Design-basis accidents	5.3.2; 5.5.1

Based on information in the GEIS, the Commission found that

> The NRC staff has concluded that the environmental impacts of design-basis accidents are of small significance for all plants.

AmerGen Energy Company, LLC (AmerGen), stated in its Environmental Report (ER) (AmerGen 2005) that it is not aware of any new and significant information associated with the renewal of the OCNGS OL. The NRC staff has not identified any new and significant information during its independent review of the AmerGen ER, the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts related to DBAs beyond those discussed in the GEIS.

5.1.2 Severe Accidents

Severe nuclear accidents are those that are more severe than DBAs because they could result in substantial damage to the reactor core, regardless of offsite consequences. In the GEIS, the NRC staff assessed the impacts of severe accidents using the results of existing analyses and site-specific information to conservatively predict the environmental impacts of severe accidents for each plant during the renewal period.

Severe accidents initiated by external phenomena, such as tornadoes, floods, earthquakes, fires, and sabotage, traditionally have not been discussed in quantitative terms in FESs and were not specifically considered for the OCNGS site in the GEIS (NRC 1996). However, in the GEIS, the NRC staff did evaluate existing impact assessments performed by the NRC and by the industry at 44 nuclear plants in the United States and concluded that the risk from beyond-design-basis earthquakes at existing nuclear power plants is SMALL. Additionally, the NRC regulatory requirements under 10 CFR Part 73 provide reasonable assurance that the risk from sabotage is SMALL. Furthermore, the NRC staff concluded that the risks from other external events are adequately addressed by a generic consideration of internally initiated severe accidents.

Based on information in the GEIS, the Commission found that

> The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives.

Therefore, the Commission has designated mitigation of severe accidents as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue, applicable to OCNGS, is listed in Table 5-2.

Table 5-2. Category 2 Issue Applicable to Postulated Accidents During the Renewal Term

ISSUE–10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections	10 CFR 51.53(c)(3)(ii) Subparagraph	SEIS Section
POSTULATED ACCIDENTS			
Severe accidents	5.3.3; 5.3.3.2; 5.3.3.3; 5.3.3.4; 5.3.3.5; 5.4; 5.5.2	L	5.2

The NRC staff has not identified any new and significant information with regard to the consequences from severe accidents during its independent review of the AmerGen ER (2005), the site visit, the scoping process, or the evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts of severe accidents beyond those discussed in the GEIS. However, in accordance with 10 CFR 51.53(c)(3)(ii)(L), the NRC staff has reviewed severe accident mitigation alternatives (SAMAs) for OCNGS. The results of its review are discussed in Section 5.2.

5.2 Severe Accident Mitigation Alternatives

Section 51.53(c)(3)(ii)(L) of 10 CFR requires that license renewal applicants consider alternatives to mitigate severe accidents if the NRC staff has not previously evaluated SAMAs for the applicant's plant in an EIS or related supplement or in an environmental assessment. The purpose of this consideration is to ensure that plant changes (i.e., hardware, procedures, and training) with the potential for improving severe accident safety performance are identified and evaluated. SAMAs have not been previously considered for OCNGS; therefore, the remainder of Chapter 5 addresses those alternatives.

5.2.1 Introduction

This section presents a summary of the SAMA evaluation for OCNGS conducted by AmerGen and described in the ER, and the NRC's review of this evaluation. The details of the review are described in the NRC staff evaluation that was prepared with contract assistance from Information Systems Laboratories, Inc. The entire evaluation for OCNGS is presented in Appendix G.

The SAMA evaluation for OCNGS was conducted with a four-step approach. In the first step, AmerGen quantified the level of risk associated with potential reactor accidents using the plant-specific Probabilistic Risk Assessment (PRA) and other risk models.

In the second step, AmerGen examined the major risk contributors and identified possible ways (SAMAs) of reducing that risk. Common ways of reducing risk are changes to components, systems, procedures, and training. AmerGen initially identified 136 potential SAMAs for OCNGS. AmerGen screened out 99 SAMAs from further consideration because they are not applicable at OCNGS due to design differences, require extensive changes that would involve implementation costs known to exceed any possible benefit, have already been implemented at Oyster Creek, are of low benefit, or are addressed by a similar SAMA. The remaining 37 SAMAs were subjected to further evaluation.

In the third step, AmerGen estimated the benefits and the costs associated with each of the remaining SAMAs. Estimates were made of how much each SAMA could reduce risk. Those estimates were developed in terms of dollars in accordance with NRC guidance for performing regulatory analyses (NRC 1997). The cost of implementing the proposed SAMAs was also estimated.

Finally, in the fourth step, the costs and benefits of each of the remaining SAMAs were compared to determine whether the SAMA was cost-beneficial, meaning that the benefits of the SAMA were greater than the cost (a positive cost-benefit). AmerGen found seven SAMAs to be potentially cost-beneficial in the baseline analysis, and eight additional SAMAs to be potentially cost-beneficial when alternative discount rates and analysis uncertainties are considered (AmerGen 2005).

AmerGen recognized that a combination of low-cost SAMAs can provide much of the risk reduction associated with higher-cost SAMAs, and may act synergistically to yield a combined risk reduction greater than the sum of the benefits for each SAMA if implemented individually. AmerGen assessed various combinations of the seven potentially cost-beneficial SAMAs identified in the baseline case. On the basis of this assessment, AmerGen identified a subset of four SAMAs, along with a priority for implementation based on individual maximum net values (SAMAs 109/125A, 134, 125B, and 127). AmerGen concluded that if these SAMAs are implemented, then the remaining three SAMAs identified as cost-beneficial in the baseline analysis would no longer be cost-beneficial. However, several SAMAs would remain potentially cost-beneficial when evaluated at the upper bound (AmerGen 2005).

The potentially cost-beneficial SAMAs do not relate to adequately managing the effects of aging during the period of extended operation; therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54. AmerGen's SAMA analyses and the NRC's review are discussed below in more detail.

5.2.2 Estimate of Risk

AmerGen submitted an assessment of SAMAs for OCNGS as part of the ER (AmerGen 2005). This assessment was based on the most recent Oyster Creek PRA available at that time, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2) computer program, and insights from the OCNGS Individual Plant Examination (IPE) (GPU 1992) and Individual Plant Examination of External Events (IPEEE) (GPU 1995).

The baseline core damage frequency (CDF) for the purpose of the SAMA evaluation is approximately 1.1×10^{-5} per year. This CDF is based on the risk assessment for internally initiated events. AmerGen did not include the contribution to risk from external events within the CCNGS risk estimates; however, it did account for the potential risk reduction benefits associated with external events by increasing the estimated benefits for internal events by a factor of 2. The breakdown of CDF by initiating event is provided in Table 5-3.

As shown in Table 5-3, events initiated by loss of offsite power are the dominant contributors to CDF. Although not separately reported, station blackout sequences contribute about 43 percent of the total internal events CDF (4.48×10^{-6} per year), while anticipated transient without scram (ATWS) sequences are small contributors to CDF (2.89×10^{-7} per year).

In the ER, AmerGen estimated the dose to the population within 50 mi of the OCNGS site to be approximately 36 person-rem per year. The breakdown of the total population dose by containment release mode is summarized in Table 5-4. Containment failures within the early time frame (less than 6 hours following declaration of a general emergency) and intermediate time frame (within 6 to 24 hours following declaration of a general emergency) dominate the population dose risk at OCNGS.

The NRC staff has reviewed AmerGen's data and evaluation methods and concludes that the quality of the risk analyses is adequate to support an assessment of the risk reduction potential for candidate SAMAs. Accordingly, the NRC staff based its assessment of offsite risk on the CDFs and offsite doses reported by AmerGen.

Table 5-3. OCNGS Core Damage Frequency

Initiating Event	CDF (Per Year)	% Contribution to CDF
Loss of offsite power (LOOP)	4.2×10^{-6}	40
Manual shutdown	6.8×10^{-7}	7
Medium loss-of-coolant accident (LOCA)	6.5×10^{-7}	6
Reactor trip	5.8×10^{-7}	6
Loss of 4160-volts alternating current (VAC) Bus 1C	5.3×10^{-7}	5
Condenser bay area feedwater flood	4.9×10^{-7}	5
Loss of 4160-VAC Bus 1D	4.5×10^{-7}	4
Turbine trip	3.5×10^{-7}	3
Loss of circulating water	3.5×10^{-7}	3
Loss of feedwater	3.4×10^{-7}	3
Others	1.9×10^{-6}	18
Total CDF	1.05×10^{-5}	100

Table 5-4. Breakdown of Population Dose by Containment Release Mode

Containment Release Mode	Population Dose (person-rem[(a)] per year)	% Contribution
Early containment failure	23.6	66
Intermediate containment failure	10.3	29
Late containment failure	1.6	4
Bypass	0.4	1
Intact containment	0.1	negligible
Total Population Dose	36	100

(a) One person-rem = 0.01 person-Sv.

5.2.3 Potential Plant Improvements

Once the dominant contributors to plant risk were identified, AmerGen searched for ways to reduce that risk. In identifying and evaluating potential SAMAs, AmerGen considered insights from the plant-specific PRA, SAMA analyses performed for other operating plants that have submitted license renewal applications, as well as SAMAs that could further reduce the risk of the dominant internal fires. AmerGen identified 136 potential risk-reducing improvements (SAMAs) to plant components, systems, procedures, and training.

Ninety-nine SAMAs were removed from further consideration because they are not applicable at OCNGS due to design differences, require extensive changes that would involve implementation costs known to exceed any possible benefit, have already been implemented at OCNGS, are of low benefit, or are addressed by a similar SAMA. A detailed cost-benefit analysis was performed for each of the 37 remaining SAMAs.

The NRC staff concludes that AmerGen used a systematic and comprehensive process for identifying potential plant improvements for OCNGS, and that the set of potential plant improvements identified by AmerGen is reasonably comprehensive and, therefore, acceptable.

5.2.4 Evaluation of Risk Reduction and Costs of Improvements

AmerGen evaluated the risk reduction potential of the remaining 37 SAMAs. The SAMA evaluations were performed by using realistic assumptions with some conservatism.

AmerGen estimated the costs of implementing the 37 candidate SAMAs through the application of engineering judgment, use of other licensees' estimates for similar improvements, and development of site-specific cost estimates. The cost estimates conservatively did not include the cost of replacement power during extended outages required to implement the modifications, nor did they include contingency costs associated with unforeseen implementation obstacles.

The NRC staff reviewed AmerGen's bases for calculating the risk reduction for the various plant improvements and concludes that the rationale and assumptions for estimating risk reduction are reasonable and somewhat conservative (i.e., the estimated risk reduction is similar to or somewhat higher than what would actually be realized). Accordingly, the NRC staff based its estimates of averted risk for the various SAMAs on AmerGen's risk reduction estimates.

The NRC staff reviewed the bases for the applicant's cost estimates. For certain improvements, the staff also compared the cost estimates with estimates developed elsewhere for similar improvements, including estimates developed as part of other licensees' analyses of SAMAs for operating reactors and advanced light-water reactors. The staff found the cost estimates to be consistent with estimates provided in support of other plants' analyses.

The NRC staff concludes that the risk reduction and the cost estimates provided by AmerGen are sufficient and appropriate for use in the SAMA evaluation.

5.2.5 Cost-Benefit Comparison

The cost-benefit analysis performed by AmerGen was based primarily on NUREG/BR-0184 (NRC 1997) and was executed consistent with this guidance. NUREG/BR-0058 has recently been revised to reflect the agency's revised policy on discount rates. Revision 4 of NUREG/BR-0058 states that two sets of estimates should be developed – one at 3 percent and one at 7 percent (NRC 2004). AmerGen provided both sets of estimates (AmerGen 2005).

AmerGen identified seven potentially cost-beneficial SAMAs in the baseline analysis contained in the ER (using a 7 percent discount rate):

- SAMA 91 – modify procedures and training to allow operators to cross-tie emergency AC buses 1C and 1D under emergency conditions that require operation of critical equipment,

- SAMA 99 – modify procedures and training to operate the isolation condensers with no support systems available,

- SAMA 109/125A – provide portable DC battery charger capable of supplying 125-V buses in order to preserve isolation condenser and electromagnetic relief valve operability along with adequate instrumentation,

- SAMA 125B – add a bus cross-tie circuit breaker to Bus 1B2 to reduce the impact of fires in the 480-VAC switchgear room,

- SAMA 127 – increase operator training on the systems and operator actions determined to be important from the PRA,

- SAMA 130 – increase combustion turbine building integrity to withstand higher winds so that combustion turbines would be capable of withstanding a severe weather event, and

- SAMA 134 – increase fire pump house building integrity to withstand higher winds so that the fire system would be capable of withstanding a severe weather event.

When benefits are evaluated using a 3 percent discount rate, two additional SAMAs were determined to be potentially cost-beneficial:

- SAMA 10 – install an alternate path to the torus hard pipe vent via the wet well using a rupture disk, and

- SAMA 132 – modify procedures to allow switching of the combustion turbines to OCNGS while running.

AmerGen performed additional analyses to evaluate the impact of parameter choices and uncertainties on the results of the SAMA assessment (AmerGen 2005). If the benefits are increased by a factor of 2.5 to account for uncertainties, six additional SAMAs were determined to be potentially cost-beneficial (SAMAs 84, 106, 124, 125C, 129, and 138).

AmerGen recognized that a combination of low-cost SAMAs could provide much of the risk reduction associated with higher-cost SAMAs, and may act synergistically to yield a combined risk reduction greater than the sum of the benefits of each SAMA if implemented individually (AmerGen 2005). AmerGen assessed various combinations of the seven potentially cost-beneficial SAMAs identified in the baseline case. On the basis of this assessment, AmerGen identified a subset of four SAMAs, along with a priority for implementation based on individual maximum net values. In order of implementation priority, they are SAMAs 109/125A, 134, 125B, and 127. AmerGen concluded that if these four SAMAs are implemented, then the remaining SAMAs identified as cost-beneficial in the baseline analysis (i.e., SAMAs 91, 99, and 130) will no longer be cost-beneficial (AmerGen 2005).

The NRC staff noted that several SAMAs that are cost-beneficial at the upper bound (95th percentile) may remain cost-beneficial at the upper bound, even after implementing the four aforementioned SAMAs. Therefore, the staff asked AmerGen to provide an assessment of the upper bound net values for these SAMAs (i.e., SAMAs 10, 84, 106, 124, 125C, 129, 132, and 138), assuming that the four cost-beneficial SAMAs noted above are implemented (NRC 2005). In its response, AmerGen provided the upper bound net values for these SAMAs (AmerGen 2006). With the exception of SAMAs 84 and 138, these SAMAs remained individually cost-beneficial at the upper bound.

The NRC staff concludes that, with the exception of the potentially cost-beneficial SAMAs discussed above, the costs of the SAMAs evaluated would be higher than the associated benefits.

5.2.6 Conclusions

The NRC staff reviewed AmerGen's analysis and concluded that the methods used and the implementation of those methods were sound. The treatment of SAMA benefits and costs support the general conclusion that the SAMA evaluations performed by AmerGen are reasonable and sufficient for the license renewal submittal. Although the treatment of SAMAs for external events was somewhat limited by the unavailability of an external event PRA, the likelihood of there being cost-beneficial enhancements in this area was minimized by including several candidate SAMAs related to dominant fire events, and by increasing the estimated SAMA benefits for internal events by a factor of 2 to account for potential benefits in external events.

On the basis of its review of the SAMA analysis, the NRC staff concurs with AmerGen's identification of areas in which risk can be further reduced in a cost-beneficial manner through the implementation of all or a subset of potentially cost-beneficial SAMAs. Given the potential for cost-beneficial risk reduction, the staff considers that further evaluation of these SAMAs by AmerGen is warranted. However, none of the potentially cost-beneficial SAMAs relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of the license renewal pursuant to 10 CFR Part 54.

5.3 References

10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy,* Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

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